# ELECTRICAL WORLD

*A consolidation of Electrical World, Electrical Engineer and American Electrician*

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*Statistical Editor*

EARL WHITEHORNE
*Contributing Editor*

FRANK R. INNES
*Western Editor*
*520 N. Michigan Ave.*
*Chicago*

H. S. KNOWLTON
*New England Editor*
*1427 Statler Bldg.*
*Boston*

PAUL WOOTON
*Washington*
*Correspondent*
*National Press Building*
*Washington*

JAMES H. RUDD
*Publishing Director*

## What in the World!

It was encouraging to mingle with 1,100 engineers at the A.I.E.E. meeting. They were in good spirits and very enthusiastic about the new things they are developing. They are not trying to save the world and have little patience with theories of economics. They are busy making inventions, developing new products and improving their operations. They are working at their jobs and enjoy their work.

●

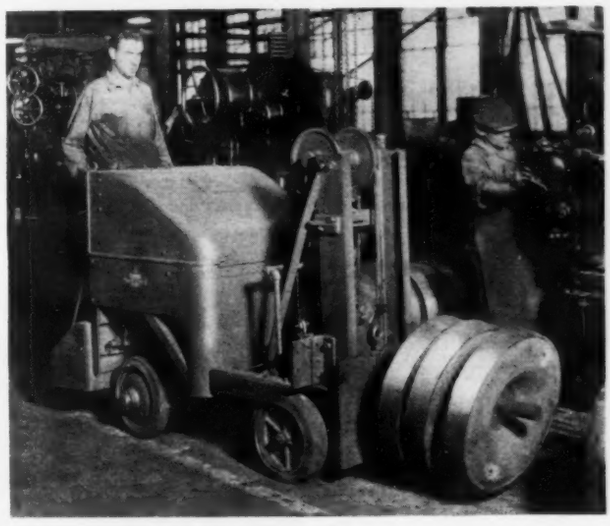
All that is needed now is the coup de grace and N.E.L.A. will be no more (p.145). Meanwhile, despite the tremendous industry interest as to the present obscure destinies of N.E.L.A. committee work and co-operative all-industry activities under the E.E.I. reformation, decisions on these matters still are pending. World's Fair officials say E.E.I. will hold its first convention there in June.

●

No lack of courage was shown by design engineers for the Hungarian State Railways, who followed an implacably logical form in devising the system; 110-kv. lines feed substations which send 16-kv. energy to the catenary. Synchronous transforming phase converters, fed directly from the catenary through oil circuit breakers, energize two-winding 1-kv. motors. Starting without inhibitions, planners avoided many familiar compromises (p. 166).

●

Not only in rates does the inducement principle pay. Slave drivers, threats or cajolery couldn't double production of billing clerks in any utility that we know of, but Toledo's wage incentive plan, with the help of modern equipment, not only did that but cut errors by two-thirds and reduced costs (p. 169).



*Electric ram-tractor material handling*

## FEBRUARY 4, 1933

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VOLUME 101 . . . NUMBER 5

At the A.I.E.E. Winter Convention.....156

An Unusual Electrification in Hungary.....166
BY ROBERT E. STOCKER

Speed in Customer Billing.....169

Remote Alarms by Carrier Current.....172
BY FRED B. DOOLITTLE, *Southern California Edison Company, Ltd.*

News of the Industry.....145
Editorials.....154
Locate Arresters Close to Protected Apparatus.....170
Transmission Towers Raised 25 Ft. Without Removing Copper.....171
Utilizing Multi-Speed A.C. Motor in Reversing Table Drive.....173
Meter Readers Contribute to Consumption Analysis.....174
Readers' Forum.....174
Men of the Industry.....175

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# ELECTRICAL WORLD

Established 1883. McGraw-Hill Publishing Company, Inc.

*for the Week Ending*

February 4, 1933

## N.E.L.A. Dissolution-Convention Called

"Please take notice that an annual convention of the National Electric Light Association for the year 1933 will be held on February 15, 1933, at 10 a.m. at the office of the association, 420 Lexington Avenue, New York City, for the purpose of transacting any and all business."

Thus tolls the deathknell of the National Electric Light Association by direction of its national executive committee, which has, "after full discussion, determined to recommend that the association be dissolved and its existence terminated; that all its debts and obligations be paid or the payment thereof provided for, and that any assets remaining be distributed by a liquidating committee," upon the basis of the funds contributed by all class A, D and F members from January 1, 1926, to the date of dissolution, to present members.

Heir presumptive to the about-to-be-deceased is the newly organized Edison Electric Institute (ELECTRICAL WORLD, January 14, page 49) with its startling departure, for a trade association, of a rigidly enforceable constitution providing penance or excommunication for those utility companies which qualify for membership and may later fall from grace to incur the possible wrath of the membership committee.

That its annual convention will be held in Chicago early in June is likely. Memberships are already being solicited from those who feel that their policies meet the constitutional requirements for admission and subject to approval by the trustees if received before April 1 or the membership committee if received thereafter.

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**As to future electric power consumption for electro chemical industries, we can safely predict that in another ten years it will be twice that which it was at the peak, in 1929; it will be at least 30,000,000,000 Kw.-hr. per annum, or about one-third the total power generated in the United States today.**

**COLIN G. FINK,**
**Electrochemist**
**Columbia University**

[ In an address before the American Institute of Electrical Engineers last week Professor Fink predicted an age of aluminum in which that metal will be used by virtually every branch of engineering in hitherto unappreciated quantities. ]

▼

## Pennsylvania Senate Asks New Utilities Inquiry

After withdrawing from the Supreme Court an appeal against the decision of the Dauphin County Court issuing a temporary writ early last month restraining it from spending the remaining $90,000 of its $100,000 investigating fund, the Senate utility investigating committee filed an appeal from the final decree of the Dauphin County Court to make the restraining order permanent. The court had ruled that the committee's fund is invalid because it was passed at a special session of the Legislature called only to consider unemployment relief and not utility legislation (ELECTRICAL WORLD, January 14, page 51). The new appeal is returnable next May, but it is expected that the committee will ask the Supreme Court to advance the argument date to the March term in Pittsburgh.

In the meantime the committee has the resolution, introduced in the Senate by Senator John J. McClure, providing for continuation of the investigation in the process of passage through the Legislature. The resolution also bestows all the subpœna and investigating power of the General Assembly on the committee and makes an appropriation of $100,000. If this resolution is adopted by the Legislature and approved by the Governor the previous appropriation would be valid.

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## Hartford Broadens Policy on Free Lamp Equities

Here and there murmurs arise as to the apparent discrimination between those who get free renewals of the larger lamps and those who pay the retail price for the smaller ones. The Hartford Electric Light Company is meeting this situation by selling the 20-cent 25-watt lamp at 12 cents in order to grant an 8-cent discount to equal the advantage gained by the larger lamp user. The 20-cent 60-watt lamp which the customer receives without charge represents to him 3.7 mills per kilowatt-hour on the 54 kw.-hr. which the lamp consumes during its life.

The same prinicple applied to the 15-watt lamp cuts its renewal charge to 15 cents. These adjustments reconcile the credit for energy consumption during the lives of the respective lamps and consequently the public is now getting the benefit of the company's long discount, which they would lose if compelled to purchase the lamps at retail.

▼

### Central Gas in Receivership

On a bill of complaint filed last week Iredell W. Iglehart was appointed receiver for the Central Gas & Electric Company by Judge Coleman of the United States District Court in Maryland. Central Gas, a subsidiary of Central Public Service Corporation, also in receivership, has subsidiaries supplying electric power, gas, water, steam, ice and transportation services in approximately 400 communities in Illinois, Indiana, Michigan, Wisconsin, Pennsyl-

vania, Maryland and Maine and the Canadian provinces of Quebec and New Brunswick. The assets of the company consist entirely of securities of public utility companies.

▼

## N.E.L.A. Meter Committee Considers Outdoor Metering

One of the topics which received major attention at the meeting of the meter committee of the National Electric Light Association in Columbus last week was that of outdoor metering. Recognized as constituting in its various phases a field where there is need for further development, the following desiderata were discussed: (1) Improvement in appearance of present boxes; (2) box should accommodate the older types of bottom-connected as well as the present single-phase meters; (3) proper space provision for test facilities; (4) size of present conventional type box should be reduced; (5) thoroughly rust-proofed materials needed; (6) simple design with minimum number of parts; (7) study of the economics of the entire installation with the preceding in mind.

That the consensus of the committee was strongly toward a recognition of various factors in the National Electrical Code which at present retard the introduction of adequate service on consumers' installations was evident. This followed recommended changes definitely recorded at the last previous meeting.

Reports presented covered not only new developments but problems and recommendations in the maintenance of maximum demand meters. It was also reported that the revised Handbook for Electrical Metermen had been well distributed to the extent of 19,234 of the 21,418 copies printed.

Round-table discussions covered inspection of kilowatt and kilovolt-ampere demand meters, energy diversion, effect of present economic conditions upon meter-testing schedules, minimum number of current transformer sizes advisable and usage of various types of sealing devices other than the conventional lead-wire seals.

▼

### Dame Is North American Head

Remaining as chairman of the board, Frank L. Dame of the North American Company has resumed the presidency of that organization, the position left open by the death of Edwin Gruhl last month.

▼

# Martin Insull Rearrested and Bailed

IN EFFORTS to obtain extradition of Martin J. Insull, formerly an officer of numerous utility companies controlled by his brother, Samuel, the state of Illinois succeeded last week in having him rearrested on a new provisional warrant citing the old charges of larceny and embezzlement, with the added charge of "theft by bailee." This move had the effect of changing the scene of the impending extradition battle in Ontario from the little town of Barrie to Toronto. Mr. Insull went voluntarily to Toronto. At a preliminary hearing before Justice Kingstone in Supreme Court bail of $5,000 was granted, which was said to be an addition to the $50,000 previously arranged at Barrie. Mr. Insull will make his formal appearance in the Barrie court February 7 and the Toronto hearing has been set tentatively for March 6.

Samuel Insull's three-month permit having expired, the Interior Ministry announced last week in Athens that it had granted him permission to remain in Grece until January 1, 1934. The Ministry said the permit had been granted before it was known that the United States had cancelled Mr. Insull's passport, but that the permit would not be affected unless Mr. Insull applied for an outgoing visa.

After witness and lawyers had assembled at bankruptcy hearings in Chicago to examine charges of collusion on the part of banks and Samuel Insull in "framing" the receivership of Insull Utility Investments, Inc. (ELECTRICAL WORLD, January 21, page 83), Referee in Bankruptcy Garfield Charles swore the witnesses and adjourned the meeting until February 9. Lewis Jacobson, counsel for the petitioning creditors of this company, filed a suit against its entire directorate, the action being taken on behalf of approximately 20,000 holders of the company's debentures under the title St. John's Church vs. Samuel Insull.

Another suit, seeking $23,233,000 from Corporation Securities Company, the $150,000,000 Insull investment trust, was filed this week in the Federal Court in Chicago on behalf of De Mets, Inc., holders of $20,000 in serial gold notes of the company, and all other investors who wish to intervene. The petition charged that the assets of the corporation were dissipated by the payment of unearned dividends, the negotiation of fraudulent bank loans and the purchasing of questionable securities for the individual profit of directors. An accounting, an examination of the directors and the recovery of what the court deems equitable was prayed and subpoenas were issued for an appearance on the first Monday in March.

In a preliminary report made to the United States District Court Charles A. McCullough and Edward N. Hurley, receivers of the Middle West Utilities Company, have stated that gross operating revenues for the eleven months ended November 30 were only approximately 10 per cent below those recorded for the corresponding period of 1931, but that an improvement in the market for new capital funds must be awaited before any permanent reorganization could be effected.

In the meantime investigators for the United States Senate committee on banking has served upon officials of Halsey, Stuart & Company, the investment house that handled the financing of a majority of the Insull holding companies, a subpœna ordering them to submit all their books to the committee.

#### Federal Trade resumes

Investigators for the Federal Trade Commission, once more picking up its investigation of Insull properties, this week traced in their testimony the building of the group and the losses which came with its collapse. In the case of Insull Utility Investments, Inc., a series of bookkeeping manipulations were cited as listing assets at $237,892,000 which then had a market value of not more than $30,402,000. Furthermore, according to C. M. Dupue, investigator of the commission, there were unpaid loans against this of $41,585,000.

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### Philadelphia Rates Reduced

Effective March 2, according to an announcement by President W. H. Taylor, the rates of the Philadelphia Electric Company will be reduced by an aggregate $1,800,000, distributed roughly as: Domestic, $700,000; commercial, $805,000, and wholesale, $283,000. Free lamp renewals are to be discontinued. Small users may find some difference in their bills, though. A domestic use of 200 kw.-hr. a month now costs $7.59; after March 2 it will cost $7.45. For 48-kw.-hr. the bill now $3.03 will be $2.84.

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### Ontario Hydro Gains by Refinancing

Taking advantage of the present low rate of sterling exchange, the Ontario Hydro-Electric Power Commission has made an estimated saving of $1,000,000 in a refinancing project involving the retirement at call of £1,200,000 of Toronto Power Company, Ltd., debentures. To finance the retirement the commission issued $5,000,000 of its own 4½ per cent five-year bonds. The new issue, guaranteed as usual by the Province of Ontario and payable in Canadian funds only, was sold at what the commission deems to be the extraordinarily favorable rate of $100.09 for the $5,000,000, costing the commission 4.49 per annum.

## Safe Harbor Wins Right to Sell Power to Railroad

Over-ruling the protests of the Pennsylvania Power & Light Company, mine operators, chambers of commerce, labor organizations and other interests (ELECTRICAL WORLD, June 18, page 1043), the Pennsylvania Public Service Commission has authorized the Safe Harbor Water Power Corporation to sell electricity to the Pennsylvania Railroad when its lines are electrified. The ruling grants the Safe Harbor company permission to serve, in addition to the Pennsylvania Railroad, three new customers, namely, the Pennsylvania Power & Light, Metropolitan Edison and the Philadelphia Electric. The commission stated that it had to balance the interest of various classes and portions of the public and make that finding which would confer the greatest benefit to the greatest number of Pennsylvanians.

The protestants claimed that if the Pennsylvania Power & Light Company, which was competing for the contract, were awarded the decision, the electricity would be generated by steam instead of by water power, thus affording a new and large customer for anthracite. The commission said that it gave careful consideration to the contention of the protestants that this order would reduce the possible consumption of anthracite by the Pennsylvania Power & Light Company. Had the Safe Harbor application been refused, it was pointed out, the railroad company could have decided to buy power from the Philadelphia Electric Company, the Metropolitan Edison, or elsewhere.

"Even if the commission were convinced that a negative decision in this case would obtain the electrification contract for protestant (Pennsylvania Power & Light Company) and that protestant would generate electric power by steam—which it is in no way bound to do—with a consequent increased consumption of anthracite coal, this conviction could not of itself determine the ultimate decision," the order stated. The Pennsylvania Railroad plans to electrify its Washington-Perryville line soon and the next project will be the Philadelphia-Harrisburg line.

▼

### Appliance Prices Cut

According to metropolitan announcements by manufacturers displaying spring lines to buyers this week, price reductions on electrical appliances will average 10 to 20 per cent. Many models have been dropped and simplification of lines undertaken. Concentration of effort this year will, it is said, be made by manufacturers to push five appliances—toasters, waffle irons, irons, sandwich toasters and percolators.

## Inflation Should Remain But a Threat

**Private resourcefulness having failed as yet to muster the necessary intensity of purpose to solve the problem of getting the business machine off dead-center, America virtually awaits with folded hands the best, or the worst, that the politicians may do. Inflation of the dollar gains daily as their pet solution. Aside from the unconscionable price of further and renewed depression that this has always brought ultimately when applied directly to the currency there are practical difficulties of execution.**

**If past decisions of the Supreme Court serve as true precedents only a constitutional amendment could negate the gold clause of $150,000,000,000 of government and private debt. Currency circulation today is unavailingly 16 per cent, or a billion dollars, more than it was in 1929, but now represents only one-tenth of the whole money supply in America. Would anything less than extreme inflation work? Such facts may throw the burden on further credit expansion instead. Today bank credit is 46.1 billions, against 58.8 billions in 1929. If inflation must come it had best be through credit expansion.**

**But the credit inflationists do not choose to recognize that actually there is no scarcity of credit today for sound enterprise. Relatively there has never been so much credit in the history of the country. Banks literally cannot find a place to loan or invest their money soundly except at negligible returns. It would appear to be not inflation of either the currency or of credit that is needed, but greater confidence in the use of the credit and currency available.**

**If we of America will balance our private, business and government budgets, whatever the cost; permit our private and international debtors to pay what it may be demonstrated that they can pay, and accept such equities and discharges as may be just; let commodity prices and producers achieve any level that they may inartificially develop; openmindedly accept the challenges of today as starting points rather than departures, and think courageously, we will be that much nearer the resumption of better times.**

## Carolina Energy Tax Case in Supreme Court Appeal

Having completed the preparation of their appeal for further legal procedure, in accordance with their announced intention (ELECTRICAL WORLD, September 3, page 296, and September 17, page 354) the Broad River Power Company and the Lexington Water Power Company carried their challenge of the constitutionality of the South Carolina energy production tax to the U. S. Supreme Court from a three-judge federal district court decree denying an injunction to prevent collection of the tax. George M. LePine, counsel for the companies, alleged several constitutional violations, including: (1) The taxing statute denies to the companies the equal protection of the laws, in violation of the Fourteenth Amendment because the tax is imposed upon the production of electricity by water or steam power, while the production of electricity by the use of oil or internal combustion engines is not taxed; (2) the law exempts from the tax industrial plants generating power for their own use or for the use of their employees, and (3) in the case of the Lexington Water Power Company the statute violates the federal Constitution in that the tax is imposed upon an agency of the federal government.

J. Frazer Lyon, appearing for the state, denied that the act results in any discrimination, pointing out that there are only two small plants in the state which are engaged in producing electricity by the use of oil or internal combustion engines. As to the exemption of industrial plants generating electricity, he contended that the state is permitted to so arrange its taxation as to favor such enterprises. He said that manufacturers have sustained heavy losses and as they afford the means of livelihood to thousands of the people of South Carolina discrimination in their favor is justified. The Lexington company was granted a permit by the Federal Power Commission. Mr. Lyon maintained that it is not acting as an agent of the government, but is engaged in private business for profit.

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## A.I.E.E. Convention Drew 1,099 Engineers This Year

Final figures for registration at the annual winter convention of the American Institute of Electrical Engineers held in New York last week and reported upon briefly on page 113 of our January 28 issue and in greater detail beginning page 156 of this issue, showed a total of 1,099 members and guests to have been officially present.

This year showed a decrease from last year and was the lowest recorded in the past ten years, but in view of business conditions represents a most encouraging direct participating interest by electrical engineers in the progress of their profession and national society. Registrations in previous years were: 1932, 1,429; 1931, 1,589; 1930, 1,607; 1929, 1,375. The highest figure in the last few years was in 1924, when 1,738 attended; the lowest, but for this year, was 1,200 in 1923.

## Coming Meetings

**Conference on Economics of Applied Lighting**—Cleveland, Ohio, Feb. 8-9. J. M. Ketch, Case School of Applied Science, Cleveland.

**Middle West Division, N.E.L.A.**—Engineering conference, Kansas City, Mo., Feb. 10-11. Thorne Brown, 1527 Sharp Bldg., Lincoln, Neb.

**National Electric Light Association**—Annual convention, New York, Feb. 15. A. Jackson Marshall, 420 Lexington Ave., New York.

**Great Lakes Division, N.E.L.A.**—Fifth annual sales conference, Chicago, Feb. 16-17. T. C. Polk, 20 No. Wacker Drive, Chicago.

**National Accounting Section, N.E.L.A.**—Committee meetings. Chicago, Feb. 20-21. A. J. Marshall, 420 Lexington Ave., New York.

**New England Division, N.E.L.A.**—Engineering Section, Boston, Mass., March 2-3. O. A. Bursiel, 20 Providence St., Boston.

**Oklahoma Utilities Association** — Oklahoma City, Okla., March 7-8. E. F. McKay, 1020 Petroleum Bldg., Oklahoma City, Okla.

**National Sales Section, N.E.L.A.**—Committee meetings, Chicago, March 21-23. A. J. Marshall, 420 Lexington Ave., New York.

**National Engineering Section, N.E.L.A.**—Committee meeting, Detroit, Mich., April 10-14. A. J. Marshall, 420 Lexington Ave., New York.

**Maryland Utilities Association**—Baltimore, Md., April 21. D. E. Kinnear, 803 Court Square Bldg., Baltimore, Md.

**Missouri Association of Public Utilities**—Jefferson City, Mo., April 27-29. N. R. Beagle, 101 West High Street. Jefferson City, Mo.

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## Pacific Coast Association to Maintain Present Status

Retention of the Pacific Coast Electrical Association as an autonomous industry organization with territory, membership and purposes similar to those under which it operated as a geographic division of the N.E.L.A. has been decided upon by the executive committee. This action followed the announcement of the formation of the Edison Electric Institute to supplant the present N.E.L.A. and possibly the Association of Edison Illuminating Companies. No provision is made for territorial subdivisions in the new E.E.I. organization, it is said.

As an economy move it was decided for the present to suspend Pacific Coast association section and committee meetings and to hold no convention in 1933. Necessary and desirable committee work which will not involve any expenditure of funds will be carried on by correspondence, although the right to call special meetings of committees as future conditions may dictate was reserved for the president and the executive committee. A special committee was appointed to redraft the constitution of the organization to conform with the changes necessitated by the dissolution of the N.E.L.A.

Involving a budget of $54,000, the program for 1933 as adopted and approved by the board of directors calls for industry co-ordination and co-operation for market development as the theme. Red Seal, appliance merchandising, industrial electrification, rural electrification and increased activity in all phases of lighting development are activities included in the plans for this year.

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## Court Reserves Decision in New River Case

After hearing testimony for both sides in the case of Appalachian Electric Power Company vs. the Federal Power Commission, Judge Luther B. Way of the United States Court for the Western District of Virginia has taken the case under advisement, indicating that he probably will render an opinion next month.

The case arises out of the complaint of the power company that the commission lacks the authority to require a major part license for the proposed hydro-electric dam on the New River, giving the commission power to supervise operations, rates, earnings and security issues. The company is asking permission to operate under a minor part license, which would curtail the commission's power to supervision of flow only (ELECTRICAL WORLD, November 5, page 614).

In the early stages of this case, which was filed June 8, 1931, the attorneys for the power company, headed by former Secretary of War Newton D. Baker, charged that the commission, in asserting jurisdiction over the proposed project, was exceeding its powers. Since then, however, the company has challenged the constitutionality of the federal water-power act and this has come to be one of the outstanding issues in the case. Mr. Baker appeared as chief counsel for the Appalachian company and his discussion of constitutional questions followed long technical argument to determine whether New River came under the classification of a navigable or non-navigable waterway or one of doubtful navigability so far as interstate commerce was concerned. He contended that the authority of Congress over interstate commerce began only when the manufactured product entered into the stream of interstate commerce.

These contentions were supported by R. Gray Williams, counsel for the State of Virginia, who made a plea for the preservation of states' rights, decrying the increasing paternalistic interference by the government with the individual and with the states. Huston Thompson, special assistant to the Attorney-General, conducting the commission's case, supported the constitutional authority of the commission and sought to demonstrate that the interests of North Carolina and West Virginia might also be affected by the New River development.

## Detroit Council Appeals to State in Rate Case

Unanimously adopting a resolution last week demanding that the Michigan Public Utilities Commission order a reduction in rates of all kinds, the Detroit City Council has asked the Governor to order a thorough-going, honest and independent audit, inventory and appraisal of the Detroit Edison Company's books and that the reduction in rates be ordered forthwith. Subsequent to the adoption of the resolution, which was drawn up by James H. Lee, assistant corporation counsel of Detroit, Mr. Lee made an attack on the commission which was resented by that body and further action impends.

Referring to the contentions of the city's lawyers, the Detroit Edison Company's brief filed last week with the commission says: "Counsels' argument with their schedules of selected and warped figures has been presented too late. The economic forces of the depression have already decreased respondent's earnings to such an extent that there remains nothing to argue about. This rate case has practically dismissed itself."

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## Commission to Investigate Power Rates in Virginia

In an effort to determine the fairness of electric power rates in Virginia, with special reference to gross income from such rates and the operating expenses of utility companies, the state Corporation Commission has engaged Allen J. Saville, consulting engineer of Richmond, to conduct an investigation. This investigation, which is to be begun immediately, will consume about one year and will cost approximately $50,000. The major portion of the expense will be borne by the three largest power companies in the state, since the Corporation Commission has no more than $13,000 available for such purposes in the present fiscal year.

The commission's inquiry will not involve inventory or appraisal of utilities' properties, but will include a comparison of Virginia rates with those in adjacent and similar territory and an attempt to determine whether the present valuation of the companies' properties are generally in line with present prices.

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### Reading to Open Electric Lines

Electrical service on the Norristown and Chestnut Hill branches of the Reading Railroad will begin February 5. The completion of this work marks the transformation of one of the first railroads in Pennsylvania into a modern electric transportation system.

## Oregon Commissioner Makes Bond & Share Code Demand

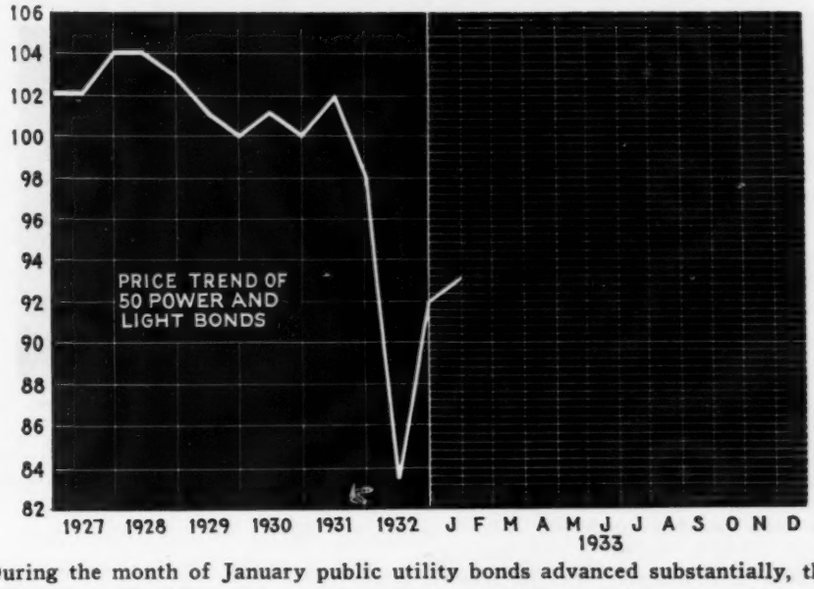
Holding the telegraphic code of Electric Bond & Share Company to be the private property of the company, used primarily to lower the cost of telegraphic correspondence, and that to make it public would destroy its value, officials of Bond & Share's Pacific Coast properties have refused to turn over the parent company's telegraphic code to the Oregon Public Utilities Commissioner, in his investigation of the Pacific Power & Light Company, Inland Power & Light Company and Northwestern Electric Company (ELECTRICAL WORLD, December 17, 1932, page 805, and January 7, page 3).

John A. Laing, vice-president and general attorney of Pacific Power & Light, asserted that no information regarding books of account or correspondence would be denied the commissioner, but that the code itself could not be handed over by officials of the companies under investigation since it did not belong to them. The commissioner has requested Mr. Laing to ask the Electric Bond & Share Company for the code, which he agreed to do. The issue arose over the decoding of a telegram pertaining to the construction of a transmission line which figured in the hearing in December. Commissioner Charles M. Thomas took the position that he could not determine whether the companies' rendering of the telegram was accurate and therefore could not conduct a complete investigation.

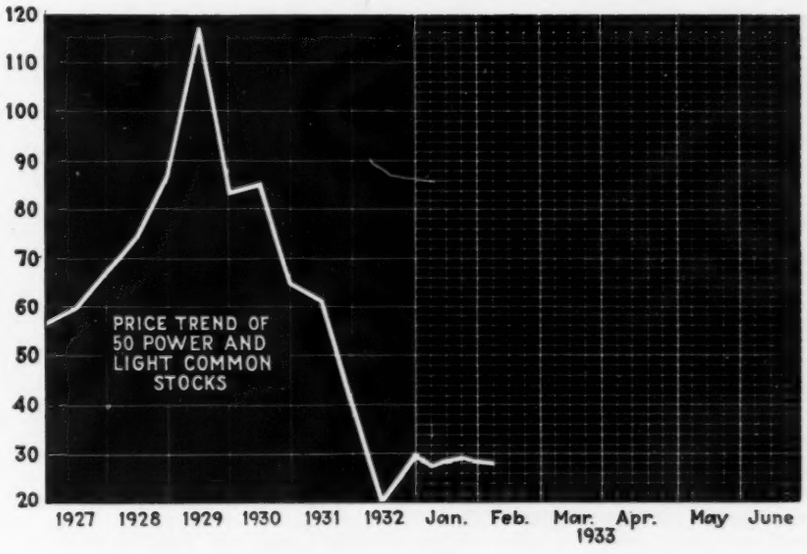
**Legislative support possible**

It was for the purpose of making a formal request for the code that the hearing was called January 24, after an interval of nearly a month. On being refused it, Mr. Thomas adjourned the hearing until after the current session of the Legislature, before which a bill, drafted from proposals recommended by the commissioner, is now pending. One of the provisions of the bill would give the commissioner the power to declare a utility "in contempt of the commission." Other points of the suggested program are: The recapture of excessive profits, supervision of utility budgets, assessment of cost and expense of investigations against utilities, incorporation of utility companies hereafter within the state, supervision of consolidations and mergers and regulation of holding company charges.

# Utility Bonds Strong; Stocks Dull




**During the month of January public utility bonds advanced substantially, the "Electrical World" index reaching 93.3, the highest point recorded since August, when 93.8 was reached. Price changes in the stock list were insignificant during the past week, the index advancing slightly from 28.3 during the preceding week to 28.9.**




## Utility Financing Totaled $24,725,000 in January

New security offerings by electric light and power companies in January totaled $24,725,000, as compared with $4,336,000 in December and $34,300,000 in January, 1932. It is interesting to note that refunding of some high-yield bonds by issuance of low-yield securities has been successfully undertaken. Operations of this sort may constitute an important part of the current year's financing, but the market for new issues remains largely selective.

| Name of Company | Issue (Par Value) | Period (Years) | Class | Purpose | Interest Rate | Price | Per Cent Yield |
|---|---|---|---|---|---|---|---|
| Consolidated Gas, Electric Light & Power Co. of Baltimore | $5,000,000 | 48 | First ref. mtge. sink. fund gold bonds | To retire bonds and for additions and extensions | 4 | 97½ | 4.12 |
| Lake Erie Power & Light Co. | 475,000 | 20 | First and ref. mtge. sink. fund gold bonds, series C | For improvements, additions and extensions, and retirement of unfunded debt | 6 | 96 | 6.35 |
| Ohio Edison Co. | 8,000,000 | 27 | First and consol. mtge. gold bonds | To refund maturing bonds and for additions and improvements | 5 | 96 | 5.25 |
| Union Electric Light & Power Co. (Mo.) | 11,250,000 | 24 | Gen. mtge. gold bonds | To retire maturing bonds | 4½ | 97½ | 4.69 |
| Total | $24,725,000 | | | | | | |

# Week's Output Recedes

Continuing the moderate decline of the preceding week, central station output fell off by another one per cent in the week ended January 28. The National Electric Light Association announces a production of 1,469,636,000 kw.-hr., or 7.5 per cent less than it was a year ago. Comparison with recent weeks shows that the usual gradual decrease with lengthening daylight is in progress but is slightly more pronounced than in 1931.

It should be noted that the relative change from 1931 was predominantly on the Pacific coast, where the difference rose to 5.2 per cent from 2.0 per cent the week before. In the Central industrial region the movement was parallel with last year's, while on the Atlantic seaboard, and especially in New England, there was a gain.

*Weekly Output, Millions of Kw.-Hr.*

| Week Ended | 1933 | 1932 | 1931 | 1930 |
|---|---|---|---|---|
| January 28 | 1,470 | 1,589 | 1,687 | 1,809 |
| January 21 | 1,484 | 1,598 | 1,713 | 1,826 |
| January 14 | 1,495 | 1,602 | 1,717 | 1,834 |
| January 7 | 1,461 | 1,619 | 1,714 | 1,816 |
| | (1932) | (1931) | (1930) | (1929) |
| December 31 | 1,415 | 1,524 | 1,597 | 1,680 |

*Per Cent Change from Previous Year*

| Region | Week Ended Jan. 28 | Jan. 21 | Jan. 14 |
|---|---|---|---|
| Atlantic Seaboard | — 6.5 | — 6.8 | — 5.1 |
| New England alone | — 6.8 | — 7.3 | — 4.7 |
| Central industrial | —10.9 | —10.8 | —10.4 |
| Pacific Coast | — 5.2 | — 2.0 | — 4.5 |
| United States | — 7.5 | — 7.1 | — 6.7 |

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## Old Dominion Hearings Resumed Before Commission

Cross-examination designed to show that valuations made by witnesses for the Virginia Coal Operators' Association (ELECTRICAL WORLD, December 17, page 804) are erroneous and without value for rate-making purposes was undertaken by counsel for the Old Dominion Power Company as the State Corporation Commission last week resumed its hearing on the petition asking for a reduction in power rates. The coal operators are asking a 50 per cent reduction in the $5,259,000 reported valuation of the power company's properties and a rate reduction of at least 30 per cent.

Upon completion of the hearings the proceedings were adjourned for 30 days to allow counsel for the coal operators time in which to examine the power company's evidence before cross-examining its witnesses.

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### Use of Electricity Up in Australia

In Australia the consumption of electricity for November, 1932, totaled 27,556,810 kw.-hr., as compared with 24,438,408 in the same month of 1931, according to a report issued by the electricity department of the municipal council of Sydney. Assistant U. S. Trade Commissioner H. P. Van Blarcom of Sydney has announced that sales of electrical appliances are improving, although it is not known whether or not they are leading or following the increased consumption of electricity.

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## Wisconsin Board Upheld by Court in Rate Cases

In order to prevent utilities from applying to federal district courts to set aside rate reduction orders, the Wisconsin Public Service Commission has exercised an obscure statute which has never been used in Wisconsin so far as can be learned from available records. Under the law, proceedings in federal court must be halted when it is invoked in a state court.

At the request of the commission, Circuit Judge A. G. Zimmerman issued an order under the statute commanding federal court to stop cases pending before it which were started by the Mondovi Telephone Company and the Neshonoc Light & Power Company. These companies appealed to federal court for injunctions to restrain the commission from enforcing its orders for reductions in rates. In effect, the order by Judge Zimmerman challenges the jurisdiction of federal courts in actions brought against the commission and is expected to halt federal court proceedings until the commission has completed its court actions to compel the companies to accept rate reductions.

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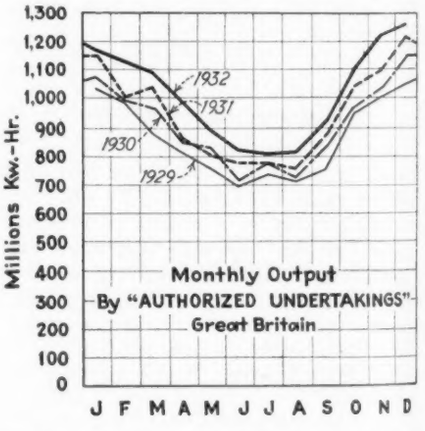
## British Output in 1932 Set New High Record

Electrical energy production in the United Kingdom, according to figures just released by the Board of Electricity Commissioners, set a new high record in the year just ended. Production by authorized undertakings totaled 12,224,000,000 kw.-hr., as compared with the revised figure of 11,413,000,000 kw.-hr. for the previous year. This represents an increase of 7.1 per cent over 1931, which in turn showed an advance of 4.5 per cent over the 1930 figure.

Energy production in December of last year was 1,266,000,000 kw.-hr. as compared with the revised figure of 1,223,000,000 kw.-hr. in 1931, an increase of 3.5 per cent.

The figures given cover only those enterprises under the supervision of the British Electricity Commission, omitting supplies utilized by railroads and street car lines as well as various private plants. In 1929 the total output of Great Britain was estimated by the British Electrical and Allied Manufacturers' Association as 16,900,000,000 kw.-hr., against the total of 10,294,000,000 kw.-hr. for "authorized undertakings."

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### Industrial Research Laboratories

Preparation of a revision of its bulletin, "Industrial Research Laboratories of the United States, including Consulting Research Laboratories," has been announced by the National Research Council, Washington, D. C. New listing of companies sponsoring such work are invited for the bulletin, probably to be published in September.

## Wood Preservers Discuss Ways to Prolong Pole Life

Desirable practices for the care of treated poles were covered in a report of the pole service record committee as an immediately practicable item that was made available to utilities and other pole users at the meeting of the American Wood Preservers' Association in Chicago last week. The care suggested is the result of an investigation by the committee on abuse of poles after treatment to recommend procedures for securing maximum pole service. Points covered include damage from pointed tools carelessly used, abuses in unloading and yard handling, neglect of sanitary conditions during storage and damages inflicted on poles during distribution to and installation in the line. That the initial toxicity of coal-tar creosote and coal-tar mixtures is considerably higher than the original toxicity of coal-tar creosote and petroleum mixtures was the conclusion of Henry Schmitz in discussing measures to combat the ravages of wood-destroying fungi.

"Heating wet wood may set up damaging stresses within the wood, especially in pieces containing the pith on account of the tangential expansion and radial contraction which takes place, resulting in radial cracks through the center and circular cracks or shakes farther out," stated Arthur Koehler. "The effect increases rapidly with increase in temperature, above 160 deg. F. and possibly even with temperatures above a lower limit."

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### Philadelphia "Renovizes"

Residents of Philadelphia have pledged themselves to spend more than $15,000,000 within the next six months in restoring, repairing and remodeling their property. The Renovize Philadelphia Campaign, under the leadership of the business and professional men and women and labor leaders of Philadelphia, urges residents to take advantage of today's bargain prices to make improvements now. H. P. Liversidge, vice-president of the Philadelphia Electric Company, is vice-chairman of the campaign.

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## Major New Construction This Week

**Virginia Electric & Power Company is arranging 1933 construction to cost over $5,000,000, including extensions and improvements on the system.**

**Machine drives, motors, conduit wiring, conveyors, etc., will be installed in plant of Industrial Rayon Corporation, Cleveland, Ohio. Estimated cost $100,000.**

**Fort Wayne, Ind., asks bids until February 14 for electric trubine units, pumps and auxiliary equipment for municipal water system.**

**Appalachian Electric Power Company plans construction of 5,500-hp. hydro-electric plant at dam at Lynchburg, Va. Estimated cost about $500,000, with transmission lines, switching station and other structures.**

**Aberdeen, S. D., plans new call for bids for electric generators, Diesel engines, switchboard and instruments and complete accessory equipment, traveling crane, etc.; also for electric distribution and city lighting systems. Estimated cost $850,000.**

**Machine drives, motors, electric hoists, conveyors, etc., will be installed in plant of Berghoff Brewing Corporation, Fort Wayne, Ind. Cost over $100,000.**

# Range Rental Plan Launched in Hartford

FOR $1.30 per month plus energy charges at the regular rates residential customers of the Hartford Electric Light Company can now rent an electric range. Effective February 1 the company launched a program providing for free wiring of the first 500 installations applied for. The range selected for rental is a specially designed outfit to be known as the "Hartford" range, having a rating of about 8 kw., four-burner table top oven and 220-volt balanced switching. Apartment house and underground service installations are not included in the free wiring plan, which was announced in commemoration of the company's fiftieth anniversary and also to stimulate quick response to the offer. Arrangements have been made whereby local electrical dealers can provide for the rental of these ranges to their customers by the company. Any range rented in 1933 will be moved once at the company's expense up to the end of 1935, and the same provision has been made with respect to makes of ranges sold to the local public.

Before deciding to rent ranges to the public the company inaugurated early in December, 1932, a plan of rental to employees at a price of 18 cents per week. A survey indicated that 150 out of 500 eligible employees with respect to location on the system were cooking electrically before the rental plan was announced. The offer resulted in a total of about 200 employees, or 40 per cent of those eligible, being listed as users of electric ranges. About half the cost of range wiring was met by the company in this program, the employee contributing approximately $20. After the first 500 ranges are signed up for rental the customer will be expected to pay approximately $18 toward the range wiring, term payments of $1 per month being allowed. The range investment will be charged to rental account and the outfits will remain the property of the company.

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## Grandstand Seats Heated Electrically in Switzerland

Will the cheering crowds at our next season's football games sink back after each rousing ecstasy of shouting to warm seats that will take the chill from watching in grim November days? They will if we borrow a lesson from Switzerland.

An installation has just been completed at the Dolder Skating Rink in Zurich, where well-insulated electric cables are placed in rows of three under the seats used by spectators in the grandstands. Tin strips radiate a uniform heat of 75 to 85 deg. F.

In order to avoid a short circuit every cable length is grounded through an automatic switch, immediately disconnecting the endangered section. The current is supplied by the same power house which provides the current necessary for the production of the artificial ice of the skating rink.

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### Telechron Patent Rights Defined

Claiming the use of any other make of electric clock but a Telechron on circuits of a power company using one of its master frequency regulator controls to constitute an infringement of patent, the Warren Telechron Company recently won a suit against the Kodel Electric & Manufacturing Company. This decision has been reversed in U. S. Circuit Court of Appeals for the Sixth District by the decision of Judge Hickenlooper, who rules that Telechron's control cannot extend beyond sale of the master clock.

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### Electrical Machinery Exports Lower

Exports of electrical machinery during the month of December amounted to $3,193,175, as compared with $3,697,630 in November and $5,733,699 for December, 1931, according to figures compiled by the Bureau of Foreign and Domestic Commerce.

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### New York Metal Prices

| | Jan. 24, 1933 Cents per Pound | Jan. 31, 1933 Cents per Pound |
|---|---|---|
| Copper, electrolytic | 5.00 | 5.00 |
| Lead, Am. & S. R. price | 3.00 | 3.00 |
| Antimony | 5.80 | 5.85 |
| Nickel ingot | 35.00 | 35.00 |
| Zinc, spot | 3.35 | 3.275 |
| Tin, Straits | 22.80 | 23.10 |
| Aluminum, 99 per cent. | 23.30 | 23.30 |

## High Water Halts Louisville Hydro

Unusually heavy rainfall in January in the Ohio river valley has resulted in the Louisville plant of the Louisville Gas & Electric Company being out of service for a week, with prospects of another week or so longer of suspension due to high water. Meantime company requirements are being supplied from its Riverside steam plant and connections with Cincinnati and lines of the Kentucky Utilities Company to central Kentucky.

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## Hydro Development of Idaho

Idaho has potential undeveloped water power of 2,704,107 hp., as compared with the present development of 292,101 hp., according to the annual report of R. W. Faris, state Commissioner of Reclamation, which also gives the potential undeveloped water storage in the state as 6,619,390 acre-feet, as compared with a present storage capacity of 4,656,500 acre-feet.

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## Belvidere Rejects Municipal Plant

Voters of Belvidere, Ill., have rejected a proposal to issue $370,000 of public certificates to finance the construction of a municipal light and power plant. The vote was 2,223 for and 1,193 against, lacking the necessary two-thirds majority.

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## Lighting Kit Promotion Spreads

Started on the properties of the American Gas & Electric Company, the plan of having company representatives call upon commercial customers, armed with a demonstration kit whose main element is a Weston "Luminometer" to prove the importance and relationships of lamp grades, reflector conditions and wall finishes, has been extended to Niagara Hudson, Ohio Public Service, Central Hudson Gas & Electric, Public Service of New Jersey and Associated Gas & Electric properties. Public Service of Northern Illinois, according to a speaker at a recent lighting demonstration at the Chicago Lighting Institute, plans similar work.

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## Georgia Appraisal Likely

That a group of "disinterested" engineers will be appointed by the Georgia Public Service Commission to place a valuation on the holdings of the Georgia Power Company has been announced by Chairman James A. Perry, at the conclusion of a series of hearings on service charges and rates (ELECTRICAL WORLD, December 17, 1932, page 807). This decision was made in the face of a measure introduced in the Georgia General Assembly which would take the valuation of property for rate making out of the hands of the commission and make it automatically dependent upon tax returns made to the state by public utility companies.

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## Appliance Rentals in Malay States

Users of electrical energy in the Federated Malay States, where the enterprise is conducted by the government, have for at least three years had the privilege of renting various appliances instead of purchasing them. In 1931 the revenue from the rental of these devices totaled $57,415 and nearly 4,000 were so placed in service. Fans predominated.

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**I suggest a depression reserve . . . that during a period of good times when industrial activity is in full swing, commissions be authorized or directed to permit a return in excess of what is needed to attract and compensate capital, and that such excess be set aside as a definitely earmarked surplus not to be made available for dividends in the period of prosperity . . . then when a period of depression comes . . . rates might be cut to furnish the relief which lowered prices and lowered incomes require.**

**DAVID LILIENTHAL,**
**Wisconsin Public Service Commission.**

[ **Commissioner Lilienthal, speaking under the auspices of the Brookings Institute in Washington last week, and moved by the need for relief which can in many instances be given only at the cost of the rights of capital, hazarded a hopeful suggestion with appalling difficulties as a practical expedient. Where may depression-proof reserves be invested? Who foresaw the extent of the present decline?** ]

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## New Illinois Commission Approved

Governor Henry Horner's new appointments to the Illinois Commerce Commission have been approved by the State Senate. They are Benjamin Lindheimer, chairman, and Andrew Olsen of Moline and Charles F. Byrne of River Forest. Holdovers are G. Gale Gilbert, formerly chairman; Paul Samuels, Phil Collins and Walter Wilson.

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## Suit Brought Against American Light

Charging that purchases of stocks had been made for the profit of interests controlling the board of directors of the American Light & Traction Company, two stockholders have brought suit to compel the company to account for alleged losses of $19,500,000. At the hearing before Vice-Chancellor John H. Backes in Newark testimony revealed that a factional split in the management of the company in 1928 between groups representing the Koppers Company and the United Light & Power Company on the board of directors made necessary certain transactions which now are being questioned.

## Wisconsin Dividend Ban Continues

Announcement has been made by the Wisconsin Public Service Commission that its temporary order to five Wisconsin utilities not to authorize or pay common dividends until a final determination is made as to whether or not company capital is impaired (ELECTRICAL WORLD, July 23, 1932, page 98) will remain effective until the companies request a hearing.

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## Rate Cut Calms Englewood

Agitation for a municipal plant in Englewood, Colo., quieted by a permanent injunction against the project (ELECTRICAL WORLD, December 31, page 872), has been further allayed by reduction in rates made effective February 1 by the Central Colorado Power Company, which serves the city. This reduction, affecting ten other communities served by the company, was ordered by the State Public Utilities Commission, and ranges from 15 to 36 per cent. Public Service Company of Colorado has also been ordered to lower rates in seventeen communities which it serves.

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## Oklahoma Rate Probe Ordered

General investigation of the electric rates charged by all companies serving in Oklahoma has been ordered by the state Corporation Commission. Twenty companies have been given until February 20 to show why rates should not be reduced. The order states that voluntary reductions in rates have not been in keeping with general reductions in other commodities.

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## New Investment Company Formed

Standard Utilities, Inc., a new investment company, has been incorporated in Maryland to acquire, for long-term investment, securities of public utility companies. It is the intention of the management to invest its funds principally in common stocks and its original investment will be confined to common stocks of certain companies in the Electric Bond & Share system. A banking group, headed by John Nickerson & Company, is making a public offering of the common stock.

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## Improved Low-Temperature Heating

Low-temperature heating fabric has been developed in England which can be installed as easily as papering a room. Resistance wires are embedded in the fabric and operate at a surface temperature but little above that of the human body. With this system and a rate of 2 cents a kilowatt-hour an average size room has been maintained under thermostatic control constantly at 63 deg. at a cost of 4 cents per 1,000 cu.ft. per day.

## New High-Voltage Rectifier Free of Complicated Parts

An arc rectifier of remarkable simplicity, free from vacuum and similar requirements, has been described in a recent issue of *Elektrotechnische Zeitschrift* by Erwin Marx. The device is acclaimed as especially suitable for continuous operation with heavy currents at extremely high voltage, thus rendering it practicable for high-voltage direct-current transmission purposes and permitting the potentiality, it is claimed, of dealing with six or seven times the power which can be transmitted with three-phase current.

The device consists essentially of two electrodes surrounded by a hard paper cylinder into which compressed air is forced. An ignition spark is produced periodically between two electrodes by means of an auxiliary emf. which may be derived from a coil connected in series with the rectifier and coupled inductively with an ignition current. The ignition spark is followed immediately by the power current arc, which is kept in motion so that the electrodes are not burned, yet which is of nearly constant length while the current is flowing to avoid variation of the arc voltage and losses.

The magnetic field of the coils causes the arc to rotate about the axis of the electrodes while the arc is driven toward the axis by the compressed air blast which flows concentrically toward the hollow centers of the electrodes. The ignition spark strikes between the nearest points of the electrodes and the arc reaches their necks shortly before the current passes through zero. The air blast is here of maximum intensity and drives the ends of the arc into zones, whence ignition is impossible.

According to Mr. Marx, valves of this type have been tested up to carrying capacities of 1,500 amp., combined with the ability to withstand 150 kv. during the reverse cycle. The efficiencies quoted are between 98 and 99 per cent. The cost of the equipment is said to be quite low. One rectifier is used for each phase of the current to be rectified. By proper timing of the ignition spark inverted (d.c.-a.c.) operation may be attained.

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## Lighting the World's Fair

Chicago will be illuminated by an artificial aurora borealis all summer, Walter D'A. Ryan, General Electric engineer in charge of the illumination of the Century of Progress Exposition at Chicago, has announced. This will appear about 100 ft. above a 90-ft. combination fountain and pillar of light which is to feature the court of the electrical building. The aurora will be formed by an arch of searchlights, all beams of which intersect directly above the pillar and spread out fanlike over the sky. The beams, it is said, will not be visible until they intersect and form the aurora, which will illuminate all the varying levels and façades of the electrical building and send its glow over the city.

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## Electronic Pencil Supplants Telautograph

That familiar mechanical system for transmitting communications across relatively short distances simultaneously with the writing of the message, the telautograph, has been greatly improved and the field of application and usefulness broadened by the introduction of electronic devices.

Latest is the cathautograph, consisting essentially of a cathode-ray tube whose electron beam is controlled by a suitable transmitting apparatus which causes the spot to move in any desired direction for any desired distance on the screen. Essential to the development is the use of special salts instead of calcium tungstate on the tube end. The special salts have a decay period in the neighborhood of thirty seconds, so that about ten words can be written and viewed on the fluorescent screen before the first one begins to fade out.

Applications, in addition to the familiar ones in restaurants, railways, storerooms, etc., are communication between airplanes and vessels and land, police cars and headquarters, noiseless instructions to broadcasting artists, foreign language interchanges and advertising purposes.

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## Packaged Cereal Sterilized by Corona Discharge

For more than a year the packaged cereal shipments of the Miller Cereal Mills, Omaha, Neb., have been degerminated against the eggs or larvæ of insect life by an electric sterilizer. Treatment consists of passing the sealed packages through a zone of high-frequency, high-potential corona, applied between two groups of rotating electrodes and a corona-concentrator below the package conveyor.

Equipment required is a motor-generator, resonant circuit and high-voltage transformer. In such installations the power demand ranges from 4 to 7 kw.

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### PORTABLE ELECTRIC STARTER FOR PLANE MOTORS

*Wide World*

**Amplification of the familiar electric hand drill idea brings a new service to an otherwise self-contained unit of transport. Airplane batteries are relieved of heavy duty in starting plane motors by this ratchet starter which plugs into the most convenient field lighting socket and is so light as to be readily handled. Lighter weight batteries can be used and the energy saved for two-way radio telephone operation.**

# EDITORIALS

L.W.W.MORROW
*Editor*

## A splendid A.I.E.E. meeting

THE midwinter convention of the American Institute of Electrical Engineers was a success. More than 1,100 engineers were in attendance and the program was unusually diverse and interesting. As reported briefly in this issue, there has been much engineering progress and there remain many unsolved engineering problems. These engineers waste little time in discussing broad generalities and find little time to debate as to who should lead the way out of the depression. Their work is technical and definite and they try to focus upon facts and opportunities. In a real sense, however, their contributions are worth much more than all the general discussions, of economic and social problems. They contribute the means to save money, to advance standards of living, to increase business and to make possible readjustments in business.

Engineers are just as human as any one, but they are busy men with definite jobs and in a sense deal mostly with practical things. This is their functional task in modern civilization. But some of them are surely capable of applying their logic, their methods and their practical business capacities to the more involved economic and social maladjustments that now exist. Without theory, without preconceived ideas and with open minds they should be able to contribute to the solution of social and economic problems. It would be well, therefore, in the future to devote at least one session of the A.I.E.E. meetings to these topics through the agency of papers presented by the ablest and most experienced men. This would at least stimulate broader thinking and might develop very useful and practical suggestions. The times have changed and professional engineering societies should discuss economic and social aspects of engineering.

## Sales plans will get business

WE HAVE tried all the schemes available and still domestic consumers will not buy. This is a common report in many territories. Another report is that filling up empty dealer and jobber shelves does no good because the goods do not move. These reports show that present selling necessitates new methods and definite planning.

Consumers have money to buy, but they are not attracted by long-term credit plans. Pay as you go should replace time payment in sales efforts. Consumer markets do not respond to door-to-door canvassing because this has been overdone by individual enterprises and because there has been no preparation or ground work through the creation of consumer desire. Jobbers and dealers are inert because they find the market thin and highly resistant, so that individual enterprises find sales costs too large. Many other changed conditions exist that must be studied if sales are to be successful.

The first essential to selling is enthusiasm and optimism, and this means that a salesman's first words should not be "business is terrible." They should be, "here is an idea and a plan that will get the business." After enthusiasm and optimism comes definite sales plans. These should start at the top and end with the ultimate consumer. A sales idea or a marketing idea must be definite and capable of detail proof to overcome the inertia of sales outlets. Beyond this it is necessary to use collective or group action to the utmost in order to increase sales pressure and reduce sales costs to participating enterpises. There is no reason for decreased business except inertia, lack of enthusiasm and lack of definite sales plans aggressively and enthusiastically applied.

## Desire for change a basis for recovery

LAST week Crosby Field, vice-president of the Brillo Manufacturing Company, injected some thoughts on current problems at the A.I.E.E. convention that are worth considering. He reminds us that every era of progress has been started and stimulated through its cycle by responding to the ever-present public desire for a change in the manner of living. Witness the pioneers' search for new land which brought forth railroad transportation, and later the desire to enlarge one's daily scope of activity which stimulated automobiles and road construction. Both created need for capital goods, auxiliaries industries and employment of people directly or indirectly in construction or production. But each time prosperity grew, overexpansion was stimulated to the point where profits diminished and it was forgotten that even the investments in these new developments might have to be written off completely some day because of displacement by future developments.

Out of this repetitive experience of past business cycles Mr. Field sees some hope and some lessons. The hope lies in the fact that most people are dissatisfied with their present mode of living or working—a factor which stimulated every previous development that led to an era of prosperity. One of the major causes for irksome living conditions is the concentration of populations in large centers, with the attendant difficulties of getting to and from work if home life is to be pursued in desirable surroundings. Mr. Field sees the possibility of widespread decentralization of business and industry and consequently decentralization of population, which, in turn, will call for development of smaller centers of activity with all the facilities for carrying on the revised commercial, industrial and social life. This means construction in its broadest sense, new outlets for employment and creation of purchasing power, which starts the cycle of any recovery.

But he warns that, to avoid the financial embarrassments which periodically occur in different industries and business, investments must be written off at a much more rapid rate and that the 25 to 99-year terms of funded debt erroneously assume that living conditions will never change in that period to make the investment represented thereby obsolete. Right now it is essential to pay off debts or arrange for their statisfactory destruction or reduction. Instead of thinking so much of efficiency or of permanency in equipments, more attention should be given to reliability of performance. With this as an aim the market for new products should increase.

## Executives in the balance

WHEN the wheels of industry are running smoothly and when employer and employee are pursuing their respective tasks in contentment and hope it is comparatively easy to be successful. At such times popular opinion lauds those who, borne aloft on the wave of prosperity, are credited for their sagacity and foresight, and the legend of the superman finds acceptance. When the tide turns and the clouds of depression gather from all sides the picture changes, and then all the executive's force of character, positive and constructive attributes must be brought into play to exert the necessary leadership. A premium is put upon ability to judge wisely as to policies and to steer enterprises safely between the exposed rocks of wastefulness and the sunken ledges of false economy.

In the electrical field executives are being weighed in the balance. Certain broad results are expected by the public, by stockholders and employees. The public demands and will have good service at fair prices. Stockholders hire out their savings for just wages. Employees look to their superiors to manifest sound judgment, full consideration of services rendered, courage to support adequate business development and to insist on the maintenance of high standards of service. Thrice happy is the community whose central-station management has been able to carry on in these troublesome times without resorting to the ruthless discharge of competent employees of long service, to the cutting of wages below bare living requirements, the abandonment of co-operative effort to increase efficiency and refusal to expend reasonable sums to save greater amounts. When we shall have climbed once again into the sunlight of prosperity, history will proclaim those who have nobly stood the test.

# Industrial and Impulse Problems Rule A.I.E.E. Convention

President Charlesworth presents Edison Medal to Bancroft Gherardi

ABSORBING a large part of the last three days of last week's A.I.E.E. convention were sessions again dealing with lightning, not so much for its own sake, as in previous years, but because of what it has started along the lines of measurement, standardization of impulse voltages and co-ordination of system insulation. Rectifiers and inverters were devices dealt with by papers and discussion sprinkled through several of the sessions. Relatively few new pieces of apparatus were announced, a low-frequency generator, a highly sensitive graphic meter and "a twin-six" thyratron condenser for power-factor correction being notable exceptions.

Power-factor measurements have been elaborated by new bridges so that the decimal point has been moved several places to the left in the last three or four years. Transportation was discussed extensively as to the communication requirements for signaling, dispatching and train control, and the power aspects in another session. Formal papers were largely supplanted by lectures in the field of sound measurement, education and electrochemistry. A single paper on high steam temperatures and pressures provoked extensive discussion of thermodynamic cycles, series and "velox" boiler designs and the economic criteria which justify attainment of additional marginal gains in thermal efficiency.

## Insulation Co-ordination and Impulse Testing

Insulation co-ordination, impulse testing and protection of static and rotating equipment against transients attracted a large attendance. Agreement has been reached by the transformer subcommittee on a tentative test procedure for impulse testing of commercial transformers, reported V. M. Montsinger and F. J. Vogel, although there is not yet complete agreement on all details. Equipment for testing, methods of applying tests, type of wave, tests to be applied and methods of detecting failures were suggested. In part it suggests that the impulse wave should be applied with the transformer excited and with the wave synchronized at or within 30 deg. of the excitation voltage crest. The two waves should be at opposite polarity at the time of synchronization. The full wave will be satisfactory if it has a nominal front of ½ to 2½ microseconds and a tail reaching half the crest in 40 to 50 microseconds from the point on the front of the wave at which the voltage is 10 per cent of the crest. Five conditions were stated which should be met when applying the tests. Failures on test may be detected by presence of smoke, excessive current or voltage drop in the excitation circuit, failure of gap or bushing to flashover when sufficient surge voltage is applied and presence of variations in the cathode-ray oscillograms.

Results of impulse-voltage testing conducted in co-operation with the Utilities Research Commission of Chicago and reported by C. F. Harding and C. S. Sprague brought forth some interesting conclusions: (1) With the usual city conditions it has been demonstrated that interconnection of transformer arrester grounds with the secondary neutral limits transformer stresses under lightning conditions to a practically negligible value even with the old non-surge-proof transformers; (2) there should be a reasonable ratio between coil insulation puncture value and bushing flashover values inside and outside the tank; (3) surge-proof transformers should have a reasonable factor of safety between insulation puncture and minimum bushing flashover values which should occur outside the tank so the transformer insulation will not be damaged; (4) if extensive use of interconnection reduces flashovers and punctures to a negligible number with non-surge-proof transformers, the added cost of surge-proof units may be warranted only for special installations.

Co-ordination of insulation was discussed at length in a paper by V. M. Montsinger, W. L. Lloyd, Jr., and J. E. Clem. They reported that data indicate there is no need for co-ordinating the 60-cycle flashover voltage of station apparatus, providing no insulation used has such a flashover value less than four times normal line-to-neutral volt-

age. It is suggested that the standard flashover of transformer bushings be 15 per cent higher than the impulse flashover of the co-ordination gap. In view of the similarity of volt-time curves for insulation and sphere gaps under short impulse waves the use of the sphere gap in parallel with a rod gap (which maintains a uniform margin of safety for insulation under other conditions) would give added protection against direct strokes on or near terminals. The necessity of using a standardized gap for comparing the flashover of apparatus was stressed, curves being given to show the spacings equivalent to suspension and pedestal insulators for different positive and negative waves. The effect of humidity on flashover of gaps was also given and, for uniformity, it was suggested that it be expressed in grains per cubic foot.

F. J. Vogel drew the following conclusions from his paper on factors influencing insulation: (1) The time-lag characteristics of major insulation are practically the same for positive and negative waves; (2) the impulse ratio is practically 2.2; (3) present standard A.I.E.E. tests for 34.5 kv. and above provide co-ordination with the proposed co-ordinating gaps, but not below this voltage, and should be increased; (4) greatest security is obtained if the surge flashover of the bushing is only slightly higher (10 per cent) than that of the co-ordinating gap.

Protection of rotating a.c. machines against lightning surges requires a limitation of the voltage of the applied wave to 2.5 times the maximum nameplate rating of the terminal arrester for a distance of at least 2,000 ft. from the machine and the use of special arresters and lumped capacitance at the machine, declared W. J. Rudge, Jr., R. W. Wieseman and W. W. Lewis in their joint paper. Capacitance of 0.1 to 0.5 mfd. may be necessary, depending on whether the machine neutral is grounded or isolated. Overhead ground wires should be placed over the exposed line to a point at least 2,000 ft. out from the station to protect this section of line against direct strokes. Where the rotating machine is connected to the exposed line through a transformer a special arrester and a capacitance of 0.1 mfd. or greater in parallel should be located between the transformer and machine.

## Discussion

The tentative impulse-testing procedure submitted raised the comment from several speakers, especially F. W. Peek, Jr., and Philip Sporn, that more study be given to methods of detecting incipient faults that may result from testing, as it cannot be said now that because the test is passed no damage has been done. To these comments, however, H. V. Putman replied that cathode-ray oscillograms do detect turn-to-turn faults but not pinhole punctures, and favors its trial over two or three years.

D. W. Roper reported that by connecting lightning arrester grounds to secondary neutrals on 15 per cent of the transformers in Chicago, serving about 100,000 customers, no adverse results had been obtained and transformer failures had been reduced 40 per cent. He urged that the A.I.E.E. seek revision of the National Electrical Code to allow such practice.

Commenting on the insulation co-ordination paper Mr. Sporn declared that it does not give a specific basis for co-ordination, that a single level of insulation in stations is not adequate unless high at the bus, that the protective value of cable capacitance is questionable and that the simplest protection of transformers is a bushing that will withstand flashover. He also pointed out that the Vogel paper does not agree with the committee report on effects of plus and minus waves and that no data have ever been presented which definitely prove the value of lightning arresters.

Mr. Vogel pointed out that while solid insulations have similar time-lag characteristics they do not have the same impulse ratios. However, he said that tests with plus and minus wave shows little difference and that some opposition to lightning arresters existed because results were based on old arresters or because new arresters are not properly applied. For indoor service he recommended the next lower voltage gap setting and favored retaining 60-cycle standards and adapting impulse ratings thereto.

The argument about what shape of waves to consider may be largely overcome, said E. D. Treanor, by using rod and sphere gaps in parallel. In view of Weather Bureau reports that humidities of 9½ grains per cubic foot frequently exist before and after storms, Mr. Monteith questioned whether 6½ grains is sufficient in tests. Another speaker pointed out that owing to the long time lag of arresters it is necessary to use short time-lag gaps to protect insulation against steep waves. Overhead shielding of lines approaching stations by ground wires was recommended.

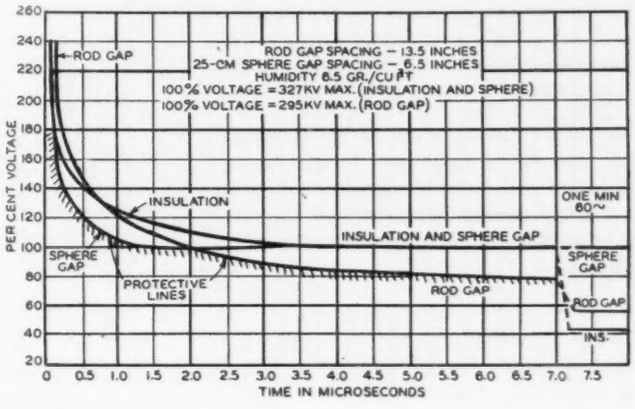
Mr. Montsinger suggested using rims on insulators for gaps and pointed out that rod gaps are inconsistent on ½/5 waves and that the lower surge impedance of cables affords some protection.

Protection of transformer windings is chiefly a problem of protecting the line ends of windings, said H. V. Putman. If the insulation is co-ordinated it is protected by the co-ordinated gap by a fairly uniform margin, at least in units rated at 34.5 kv. or more.

Regarding the paper on protection of rotating machinery, E. M. Hunter and R. Treat warned that not merely the crest but the wave front of the surge wave must be considered. Lightning arresters alone or even 1:1 transformers are not sufficient and must be supplemented to reduce voltage across turns and at neutral. Series inductance of about 0.02 henry in the leads would help, he declared. J. F. Calvert suggested lumped capacitance at terminals, and urged considering flat-topped zero front waves and substantiation of theory with tests. Another speaker presented several graphs showing the stresses imposed on generators with different waves when using delta-wye and wye-wye transformers and suggested lightning arresters on the high side and condensers on the low side to protect rotative equipment.

**Protection afforded insulation by combined rod and sphere gap**

(Montsinger, Lloyd and Clem)
Based on a 1.5/40 positive wave. Intended to approximate the curve of a sphere gap as might be affected by dirt and other adverse conditions in practical installation.




## Proposed standard test waves win favor

Discussion of lightning focussed about the recommendation of the lightning and insulator subcommittee that three test waves (½/5, 1/10 and 1½/40) be employed for application of surge voltages to electrical apparatus to ascertain its performance under impulse conditions. The ½, 1 and 1½ refer to the microseconds of time to reach the crest and the 5, 10 and 40 to the microseconds from the initiation of the impulse to the time when the tail of the

wave reaches half the crest value. Specifications are given with respect to the test circuit, the polarities, temperature, pressure and humidity and the accuracy of the measuring devices.

In discussing the proposals K. A. Hawley emphasized the necessity of observing the recommendation that both positive and negative impulses be applied because insulators differed as much as 30 per cent between the two polarities, whereas the co-ordinating gap responds about equally to both. In the opinion of P. L. Alger discrimination would have to be used in the use of these standard waves; it would be unfair to apply the same wave to pieces of equipment like generators, which have a high inherent capacitance, and to devices which have a practically negligible capacitance. As to the recommendation that the wave characteristics be calculated as well as measured, C. L. Fortescue felt that rigorous calculation is often tedious for complex test specimens or set-ups and that full reliance should be placed on the oscillograph record if it is obtained with a voltage divider having adequate fidelity. It was his opinion that the time-lag characteristics of electrical apparatus should be studied by the various laboratories, because nothing will give more significant indications of the most effective manner of co-ordinating insulation.

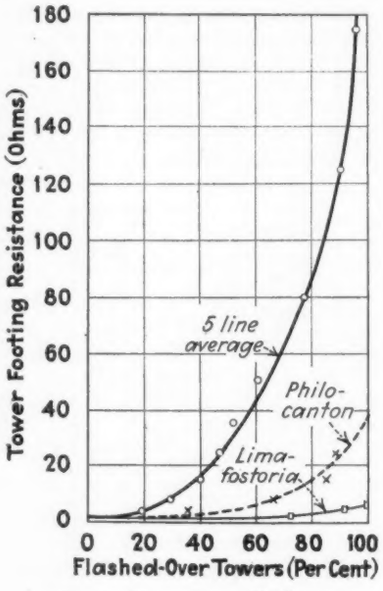
C. M. Foust and K. B. McEachron both cautioned against ignoring the front of the wave on the assumption that the time lag of apparatus was in general such that flashovers will occur entirely on the tail of the test waves. The latter also suggested that equipment be connected to actual lines when tested in order to eliminate the phase-difference departures of the laboratory test from the in-phase relation existing in a line test. Philip Sporn, who presented the report, agreed with several commentators that study of the time lag of the sphere gap should be prosecuted and its calibration range extended.

### Voltage dividers give differing results

Briefs for the resistance and capacitance types of voltage dividers in connection with impulse voltage measurements were afforded by two papers (one by Dowell and Foust and the other by P. L. Bellaschi). These constituted the contributions of the instruments and measurements committee to the three-cornered lightning program. In spite of the confidence of each camp in its preferred type of divider there are differences of 20 per cent often obtained on the same specimen when tested in the respective laboratories. This discrepancy is likely to be eliminated shortly by co-operative action if the pleas made by E. S. Lee and F. C. Hanker can be interpreted as presaging joint agreement.

# Lightning Outages Reduced— Wood Construction Surveyed

Studies of lightning experiences on lines previously reported by W. W. Lewis and C. M. Foust confirm in the 1932 data the effective contribution of the ground wire and lower tower footing resistances. The latter is often obtained by the use of a counterpoise. For given conditions it is now practicable to write line insulation and permissible




**A. G. & E. towers flash over even with only 5-ohm ground resistance**
(Sporn)

tower footing resistance stipulations which will insure practical immunity from flashovers. After several who discussed the paper had indicated their acceptance of a 2 to 3 or 4 to 5 ratio of d.c. ground resistance to surge impedance, thus making the d.c. ground reading adequate by itself, A. S. Brookes disputed this assumption. He bolstered his refusal to accept it by citing some tests he had made in conjunction with determining the effectiveness of a counterpoise in reducing ground resistance. In one case the d.c. resistance measured 48 ohms and the high-frequency impedance 128 ohms before the installation of the counterpoise; after its installation the d.c. resistance was down to 2 ohms, but the impedance had dropped only to 48 ohms. He urged the desirability of developing devices and technique for determining ground impedance on a surge basis as a substitute for the prevailing practice of measuring only the resistance. P. L. Alger joined in the plea.

Four previous analyses of lightning experience on the 132-kv. lines of the American Gas & Electric Company were extended by a fifth paper presented by Philip Sporn. The growth in connected capacity and lines appears to have a definite result upon the per cent of outages (40 per cent in 1931) involving both lines, although the actual number of total outages per 100 miles of line per year has been decreased from 29 in 1926 to sixteen in 1931. None of the recent outages necessitated holding the line out longer than the time necessary to close the switch. It was stated that increase to 132-kv. insulation on 33 to 66-kv. lines has not proved sufficient to prevent power follow-up after a lightning flashover.

The distribution of top, middle and bottom conductor flashovers involving single-phase faults (28.9, 22.8, 22.1 per cent respectively, totaling 73.8 per cent) does not seem to sustain the theory that even the majority of outages have been the result of direct strokes to lines, towers or overhead ground wires. Absence of ground wires on the wood-pole lines may account for the failure apparently to realize the benefits of wood as insulation against lightning.

Messrs. Marquis and Gross discussed this paper, the former emphasizing the greater virtue of the automatic oscillograph over the relay target in registering outages. The oscillogaph in one instance differentiated as distinct two flashovers on two adjoining circuits which the relay targets would have indicated as a double-circuit flashover. Actually the second line did not flash over until three-quarters of a cycle after the first line had cleared.

Considerably lower tower footing resistances than have been tolerated in the past will be needed to assure a lightning-proof line, in the opinion of I. W. Gross. Over-insulation on medium-voltage lines does not seem promising as a lightning preventive even where low tower footing resistances are obtained. In closing the discussion, Mr. Sporn said the attainment of low ground resistance was the most difficult of the three requisites for a lightning-proof line.

Public Service Electric & Gas Company and Westinghouse engineers (Brookes, Southgate and Whitehead) co-operated in studying impulse and dynamic flashovers on several types of 26-kv. wood-pole construction.

A companion paper on operating experience with wood designs against impulse flashovers on Electric Bond & Share Company lines was presented by H. L. Melvin. Guidance for such de-

signs is found in these conclusions which are taken from the paper:

1. High lightning insulation in itself, such as is practicable by utilizing wood guy insulators, poles and crossarms, is not effective in materially reducing the number of lightning flashovers occurring on transmission lines.

2. The three general types of design for lines to minimize lightning influence, which at present seem most adaptable and in which the lightning insulation strength of wood can be employed to advantage, are:

(a) Diversion of lightning strokes from the power conductors without permitting insulator flashover.

(b) The drainage of lightning strokes through "dynamic follow" current-interrupting devices.

(c) The simple design in which no particular attempt is made to avoid lightning flashover.

But if there is so much virtue in wood, why ground? asked K. A. Hawley. He was disposed to believe that the wood crossarm has a definite place in practical construction, but it is evidently a structural and protective question to be decided on economic grounds as well as technical.

Broadly applicable to the whole group of papers were the comments of F. W. Peek, Jr., and E. S. Lee. The latter contrasted the present degree of satisfaction in lightning control with the hectic state of affairs some seven years ago. Lines were then popping faster than they could be restored or the reasons ascertained. Now, said Mr. Peek, the data and protective technique have accumulated to the point where lines can be designed against known values of impulse voltages and currents. We have moved a long way from merely charming away the lightning surges.

# Industrial and Transportation Applications Reported

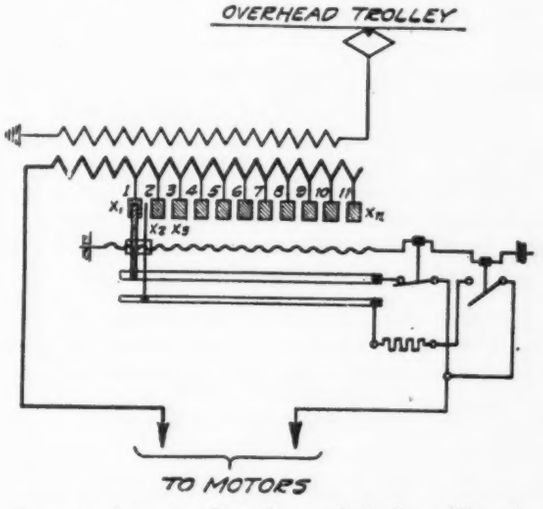
A fundamental approach to planning of power supply systems for electrified railroads and operating results obtained at the Cleveland terminal constituted two papers which were received with special interest at the transportation session. Requirements in air-conditioning passenger cars and suggestions on how to meet them, characteristics of a simple tap-changing speed control for single-phase locomotives and a method of calculating control characteristics for such motors were the themes of three other papers.

The paper on power supply, by P. A. McGee and E. L. Harder, had the advantage over the customary paper on individual systems that it permits ready comparison of different methods and greatly assists preliminary design. Considerable unit data on different types of service as well as electrical index figures for specifying load characteristics were given for determining probable substation spacings and loads, catenary r.m.s. current and regulation under peak traffic conditions without having to assume the magnitude of trainloads. Part of the paper gave a perspective of power system requirements with various systems through a general study of transmission and distribution based on a number of assumed trainloads. Fleets of trains of equal size and uniform spacings are made the basis for the generalized solutions as well as studies of specific load conditions.

At the Cleveland terminal, pointed out F. H. Craton and H. W. Pinkerton, about 1,000,000 miles of electric operation have been recorded in the past two years, about 80 per cent of which was in passenger revenue-miles and the rest in switching. Availability of the 22 locomotives used averaged about 92 per cent and utilization factor about 54 per cent, but it is expected the utilization will improve with traffic. The all-day average of energy consumption in coach-yard switching was about 55 kw.-hr. per locomotive excluding auxiliaries. Brushes last from 50,000 to 100,000 miles and pantograph strips average 8,000 miles. There were twelve engine delays of three or more minutes, half due to man failures and half to electrical causes, or about 170,000 locomotive-miles per electrical failure.

Air-conditioning equipment for railroad passenger cars, said W. C. Goodwin and Charles Kerr, Jr., must be very compact, quiet and able to maintain a temperature of 82 deg. and a relative humidity of 60 per cent when the outside temperature is 95 deg. or more. About 2,500 cu.ft. of air per minute (25 to 30 per cent fresh air) is required. These requirements can be met with 6 tons refrigeration capacity per car and a 12-hp. motor driven from a 15-kw., 32-volt axle generator coupled with an 800 to 1,000-amp.-hr. battery. Precooling can be handled by a separate 220-440-volt, 60-cycle motor connected to station or terminal circuits. In the equipment described a high-speed compressor and air-cooled condenser are used.

The tap-changing speed control, described by W. A. Giger, requires only two contactors mechanically interlocked with the tap changer, very little space on top of the transformer and little cable connection as the tap changer is connected directly with the transformer taps. A similar tap changer that operates on the primary of the transformer instead of the secondary was illustrated. Tests presented on one locomotive showed a fluctuation in drawbar pull during acceleration of only 24 per cent, compared with 55 per cent for preventive-coil control. Weight of the complete control equipment including transformer was given as 13 per cent less compared with a comparable preventive-coil installation.




**Low-tension tap-changing switch for railroad motors with only two contactors**
(Giger)

### Discussion

Discussion of the power supply paper drew forth major discussion from Mr. Hamilton, New York Central; S. Withington, New York, New Haven & Hartford, and F. R. McLeod. A 5 to 10 mile spacing of 3,000-volt substations was questioned by Mr. Hamilton, who reported hauling eighteen-car passenger trains and 3,500-ton freights on 660 volts with 5 miles between manual substations sandwiched by automatic stations during peak loads. On the other hand, he declared he never heard of spacing substations 20 to 30 miles apart.

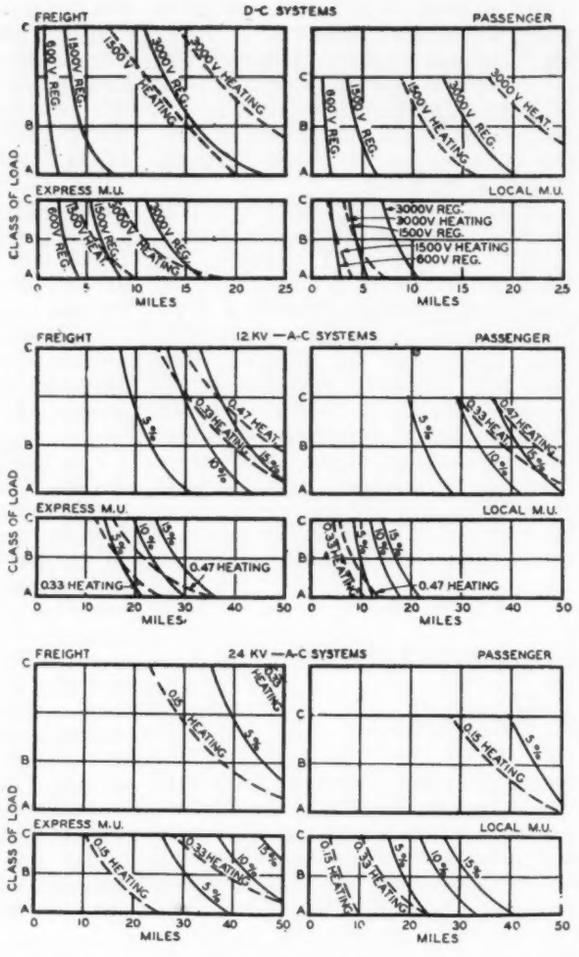
Mr. Withington called attention to the fact that load factor increases with the length of the route electrified and by electrifying a variety of classes of service that have diversity of load, thereby increasing utilization of the investment.

Although power supply is supposed to be subordinate to traffic, he declared that greater economies can probably be effected by proper spacing of trains

**Railroad substation spacings for different services**

(McGee and Harder)

As limited by 50 deg. C. temperature rise of aerial and by average regulation. Figures on heating curves indicate trolley conductivity in millions of circ.mils. Percentages are average regulations.




than by possibly any other method. Considering all equipment involved it may be economical to space substations farther apart than trains. They might be located at interlocking points for flexibility of operation and to utilize the same personnel.

Mr. McLeod, in referring to the use of three-winding transformers, pointed out that through feed is dependent on relation of transformer impedance to system impedance. Various uses of index figures given by the author were indicated, such as figuring regulation, selectivity, short-circuit current, spacing of high-speed breakers, etc. The problems of selective relay operations on tie buses was emphasized. Higher voltages can be used for railroad operation if desired, so far as equipment is concerned, especially if electron tubes are used on d.c. systems. He recommended feeding railroad substations from adjacent transmission systems rather than from special railroad transmission lines because of greater reliability.

## Electron tubes find diversified applications

Recent applications of electronic devices for industrial control constituted the outstanding feature of the industrial applications session, which also devoted attention to circuit breaker protection of industrial circuits and variable-voltage oil-well drilling equipment.

Industrial applications of electronic tubes was given added impetus by the perfection of high-current vacuum and grid-glow tubes, declared F. H. Gulliksen. Several installations indicate their superiority over conventional electromechanical equipment, he said, but they are particularly adapted to performing functions that cannot be accomplished by conventional controls and where high sensitivity and quick response rule. Among other advantages are simple means for preventing hunting, absence of inertia and radio interference, various permissible mounting angles, freedom from noise, compact controls and small maintenance. The life of electronic tubes, at rated current, ranges from 2,000 to 5,000 operating hours for grid-glow tubes and from 3,500 to 10,000 operating hours for high-vacuum tubes. Increased life can be obtained by operating the tubes below rated current.

As speed regulators their sensitivity can be kept within ± 0.5 to 1 per cent and as voltage regulators ± 0.2 volts or better. By applying photocell control to paper draw rolls the amount of wasted paper, which at present may be up to 15 per cent or more, will be considerably reduced and the number of attendants, in most cases, reduced from 3 to 2, it was reported.

Constructional and performance features of small circuit breakers designed for industrial circuits, to take the place of knife switches and fuses, and small oil and carbon circuit breakers were presented by H. J. Lingal and O. S. Jennings. They claimed for these breakers: Small space requirements, low cost, safer and more satisfactory service. Time-load curves were presented.

In discussion of electronic devices, W. R. King referred to an arrangement for accurately timing the duration of current in spot welding. R. E. Hellmund pointed out that electron tubes can substitute for many operations that usually require exercise of the human senses, that there is hardly any limitation to possible applications and that the cost thereof will go down as usage becomes more extensive, although benefits are derived which justify paying more in many cases.

The paper on oil well drilling, by A. H. Albrecht, embodied an analysis of the advantages of several combinations of generators and motors—differential compounded and shunt generators in series and parallel, with shunt and compound motors — using four gear ratios to load the generators as uniformly as possible. However, the author left it to the individual to choose which characteristics he preferred.

## Big growth in electrochemical processes foreseen

Applications of electricity to chemical and metallurgical processes, methods of controlling industrial processes by light sensitive cells, factors that influence the resistance of storage battery separators and the production and benefits of oxygen-free high-conductivity copper were the themes of four papers presented by Colin G. Fink, J. V. Alfriend, Jr., George W. Vinal and P. H. Brace respectively.

Dr. Fink presented a picture which should urge every electrical man to acquire a better knowledge of the part electricity is already playing in the electrochemical and metallurgical fields and how its use may be greatly increased if the benefits of these and other uses are more widely disseminated among industrials. Power cost is a major item, so this may play an important part in extending the field of application, but even now electricity has made possible processes that could not be performed economically before. And the products, in turn, have stimulated industrial developments. Radical changes may be expected in the next ten years due to electric alloys and the use of power for processes mentioned may be expected to increase to 30,000,000,000 kw.-hr., or one-third of the total energy use, in 1929.

The practical significance of Dr. Vinal's study of battery separators is that it throws light on factors that influence storage battery capacity and is hoped to lead to a more rational way of specifying battery separators.

In general, the oxygen-free copper discussed, which has a conductivity of 101 to 102, compared with 80-85 for commercial copper, and is highly ductile and uniform, is produced by melting electrolytic copper in an electric furnace containing inert gases, pouring into vertical molds and annealing. It

was reported that it has been found particularly suitable where edge bending of magnet coils would cause edge fractures or slivers on ordinary copper and where the slivers would later cause insulation breakdown. Some divergence of opinion was expressed by W. H. Bassett, Jr., and Sydney Rolle as to whether the desirable characteristics were produced chiefly by pouring into vertical molds, this being given chief credit by Mr. Bassett.

### Factors that influence welding performance

Further inroads on some of the "mysteries" of the electric arc were discussed at the welding session, where the practical value and control of transients in welding generators were also considered. Investigations of the high-velocity vapor stream in vacuum arcs were reported by R. C. Mason, who declared that the copper arc stream attains velocities of 1 to 2.5 x $10^6$ cm. per second and that of a mercury arc 2.24 x $10^6$ cm. per second. One theory of the cause of this high velocity is based upon the presence of multiple-charged ions which leave the cathode after neutralization. The possibility that this stream has something to do with the effectiveness of an arc in welding and other functions was suggested by Dr. Slepian.

An analysis of the arc formula was submitted by J. L. Myer, who interpreted it in terms of energy and showed that there is a minimum energy requirement of $A$ watts per unit of current, implying a minimum potential in drawing the charged particles into or out of the electrodes and the highest efficiency in conveying these charges through the arc stream. Then there is an excess energy requirement watts per unit of current, composed of the combined electrode falls and the surface losses per unit volume of discharge volume. The exponential factor is proportional to anode temperature, so the higher the temperature the more efficient the arc. The largest proportion of the excess energy losses probably results from heat and light radiation and ionic diffusion from the arc stream. Under the effect of the directed field this extra energy would be contributed as heat to the electrodes. This energy analysis of the arc was commended by A. R. Miller, because it takes into consideration thermionic forces, arc field, surrounding medium, etc.

Transients play a very important part in welding performance, declared Mr. Miller in a paper which analyzed the overshooting of armature voltage and field current with changes in mutual inductance of the armature and field. The "overshooting" is less the lower the mutual inductance, which can be controlled by an excitation circuit interlacing the series field and reactor in the welding circuit.

F. Creedy also presented evidence to show that transients can be reduced or eliminated by transformer-reactors linking the field and armature of welding generators and stated that it is the verdict of practical welders that performance is better with controlled transients. The voltage recovers quicker after short circuit with neutralized generators, he pointed out.

What is needed now are more specific statements regarding the magnitude of transients needed for satisfactory performance, declared P. L. Alger. It is also a question whether interlaced windings necessary with neutralized generators are preferred over separate control in view of manufacturing difficulties with the former.

A 900-cycle double-inductor generator capable of supplying several arcs at once was discussed by G. A. Johnstone, who claimed for it: No transients that affect welding, low open-circuit voltage, inherent regulation, high efficiency, self-excitation, low weight and cost, three-phase loading of power supply and rugged construction.

Professor Creedy reported that 300-cycle generators in Europe produced very stable arcs and that he believed they have a future, although Europeans have preferred d.c. where a rotating machine is used. Dr. Slepian questioned the ability to strike arcs cold at 65 to 75 volts.

## New Ideas on Protecting Service

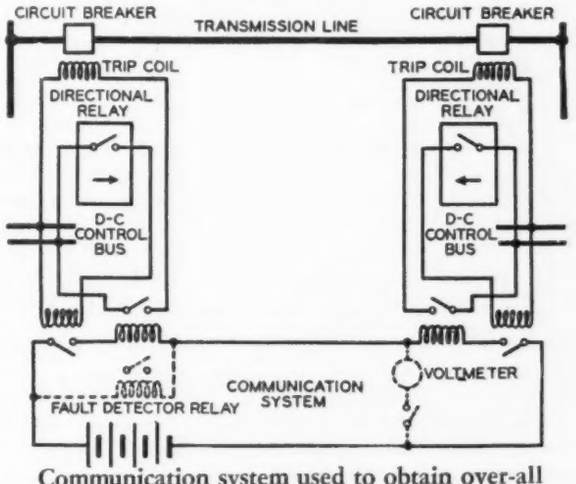
That relay protection of service continuity is a major problem despite the apparent insignificance of the devices was demonstrated by the auditorium packed with members who attended the session on protective devices. As H. R. Woodrow said, "Although relay protection constitutes only 1 per cent of the system investment, probably no other item has played a more important part in the development of reliability."

Three aspects were discussed in the four papers presented: Use of communication facilities in relaying transmission lines; protecting equipment and service; use of phase-sequence principles in relaying secondary networks. Judging from the discussion which ensued the first and last subjects created the most interest.

J. H. Neher's paper on transmission line relaying received extensive commendation, although it was not considered a panacea by either the audience or the author. In general, over-all protection of transmission lines is accomplished by comparing the relative directions of fault current at the terminals of any line section. This arrangement resolves into a directional-relay system at each end of the line interconnected by a communication system. Directional comparison secures all the advantages of differential protection, says the author, and, by substituting a communication system for a.c. pilot wires, results in a simpler, more reliable and less costly installation.

Standard directional relays are utilized which, in a certain number of cases, may be component parts of the normal or back-up protection of the line. A communication system can also be used to link the trip circuits at the ends of a transmission line provided with any conventional protection, thus insuring the simultaneous tripping of both line ends for all fault positions.

Mr. George expressed accord with most of the conclusions, saying that he has a 14-mile section of 110-kv. line with pilot-wire protection, tests of which showed very rapid and accurate protection. To secure these results, however, it has been necessary to shunt each relay with a 2-mfd. condenser so the charging current drawn by the pilot wire under some conditions will not operate the relays. A d.c. telegraph circuit is preferred for interlinking the relays, also three single-phase elements with torque restraint for phase protection and high-speed directional relays. Detection of open or short circuits in the pilot circuit is simple, he declared.




**Communication system used to obtain over-all protection by directional comparison**
(Neher)

References to the use of pilot-wire systems in England and Australia were made by G. B. Dodds, who said that only the breaker closest to the fault operates, the others being locked out by the pilot wire. In his opinion the arrangement described by Mr. Neher handles situations that could not be handled before, but it will supplement rather than supersede the a.c. pilot-wire system.

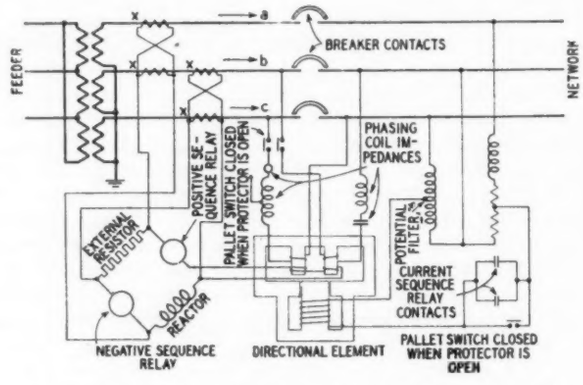
The method presented is important, in E. H. Bancker's opinion, because relays dependent on local conditions only cannot handle all cases and because conditions at the other end of the line section provide essential controlling factors. Tapped lines can be arranged in loops for relaying with this method so multifeed will be afforded non-faulty sections. Reference was made to a carrier-current pilot-wire scheme for centrally indicating positions of all directional relays on transmission systems. If the pilot wire is also a communication channel it is thereby checked periodically for reliability. Besides confirming advantages given by Mr. Neher, he pointed to the greater freedom afforded designers thereby.

Over-all protection rather than point-by-point protection, which will be simultaneous and instantaneous, was commended by H. P. Sleeper. However, he reminded that the higher cost of pilot-wire systems must be justified by added benefits. Frequently, balanced, ground, phase or distance-type protection will suffice and be cheaper. The ideal system is one that will operate relays at opposite ends of sections simultaneously as well as instantaneously, he declared, and it will probably combine distance relays with pilot wires or carrier control.

The most serious fault of previous relay schemes, remarked C. A. Muller, was the absence of simultaneous high-speed clearing of faults on two-circuit lines. He referred to experience (ELECTRICAL WORLD, September 10, 1932) with a carrier system of co-ordinating directional relays which determine whether faults are internal or external. Preference was expressed for carrier-current control over leased or private communication circuits.

On the other hand, R. J. Wensley referred to the weaknesses of carrier current such as tubes, line traps, couplings, etc., and commended the reliability of leased communication circuits in cables. He favored the pilot-wire arrangement in which the directional relays function when no pilot signal is transmitted so the protective scheme is safeguarded against pilot-wire failure. More money can be spent for protective systems if they have sufficient additional advantages, but he warned against adopting the pilot-wire scheme as a panacea when existing systems will serve. However, he admitted it has a special field of application on tie lines.

Preferred practices of some 37 companies in protection of electrical apparatus, were submitted for the relay subcommittee by O. C. Traver. Special attention was given to a.c. generators, power transformers, a.c. motors, buses and neutral grounding equipment, but d.c. generators and motors, frequency converters, synchronous condensers, and converters, and rectifiers were included. Inasmuch as considerable discussion of the subject had been received before the convention, Mr. Traver modified his printed presentation somewhat.




**Sequence relay protection of secondary network**
(Orcutt and Bostwick)

Two different viewpoints possibly explain such differences as exist—one is based on protecting the monetary value of the equipment and the other is based on continuity of service to the customer; the latter factor seems to dominate. Differential methods have become more extensive due to the ability to clear faults in their incipient stage, but this method is not so good in bus protection. More care is needed in the selection of current transformers, and the effect of magnetizing transients on high-speed relays may have to be avoided by delayed or suspended action. Time delay of 1½ to 2½ seconds (mostly two seconds) seems advisable on undervoltage protection of motors to allow them to coast through temporary voltage drops, although some industrial processes do not permit any voltage interruption.

The papers on "Application of phase-sequence principles to relaying a.c. secondary networks," by H. R. Searing and R. E. Powers, and "A sequence relay for network protectors," by H. S. Orcutt and M. A. Bostwick, were closely related. They consider an improved method utilizing a conventional single-phase directional element and two contactor-type overcurrent elements excited by symmetrical phase-sequence components to represent completely power flow conditions and control protector operation on a three-phase, four-wire secondary network system. The system was devised to prevent the large number of unnecessary protector operations due to power reversals from (1) periodic heavy shunt load drawn from substation buses from which network feeders emanate, (2) individual feeder loading and regulator action, (3) phase-angle and voltage differences in individual generating sources due to loading, etc., (4) starting of large induction-synchronous motors, (5) elevator regeneration during breaking.

With the new relay system a master directional element indicates direction of power flow, phasing features control protector closing, selective tripping prevents opening of protector upon reversal of energy during normal operation with the feeder breaker connected to the source, and the protector is tripped when the feeder is disconnected. Experience totaling 400 relay months has been obtained on the United Electric Light & Power Company's system.

Elimination of unnecessary operations (3,000 to 5,000 per protector per year) is necessary, agreed W. J. McLachlan, who declared that the paper points the way where feed is from several sources and where there is considerable elevator load. But the method of obtaining negative sequence current is not applicable to some systems, he declared. Furthermore, the requirement of 8 per cent negative sequence current may produce overvoltages by the method used on some systems, so other methods must be considered. With such a multitude of devices failure of any one would prevent operation, he contended.

At least three speakers—J. A. Brooks, C. M. Gilt and W. R. Bullard—declared that further simplification of network protection is necessary. Too many requirements are held over from early conceptions of networks, which have not materialized. Some unanticipated requirements have arisen. Mr. Brooks specified the conditions under which the protector should open or close, pointed to necessity of greater reliability without frequent inspection, objected to the back-up fuse and advocated complete redesign in view of latest knowledge, placing the relay and switch together.

### Automatic stations perform well

Experience with the fully automatic substations of the Cincinnati Street Railway Company has been so good that the social benefits from a perfect transportation record for more than two years justify, in the opinion of J. A. Noertker, the $1,862,400 that was spent for the nineteen substations including $164,000 for the supervisory control

equipment and the control cable. For maintenance of substation equipment, including the supervisory system and cable, $21,890 was spent in 1931.

But Mr. Noertker read little of this or any other part of his paper. He felt impelled to engage in a technocratic discussion of automatic control equipment and its bearing on technological unemployment. He held a brief for taking the long-range view with the expectation that spiritual leaders would soon arise to confirm the need for science and invention if the standard of living is to continue advancing. R. J. Wensley admitted that automatically controlled stations had displaced men from jobs, but those jobs were the dreariest of routine jobs, the kind which should be eliminated as part of an objective of attaining an interesting life without drudgery or monotonous repetition.

Much of the influence of automatic equipment for electrical control upon unemployment is unfairly implied if it does not take account of the fact that supervisory control accomplishes things today which no one man, nor even an excellently co-ordinated group of men, could be expected to accomplish in the direction of continuity of service and safeguarding of expensive equqipment. This point was made by A. E. Anderson, who added that this is the prime function of automatic control and not to displace men from operating jobs. Many of the jobs which were eliminated were monotonous and largely devoted to sitting around, waiting for something that seldom happened.

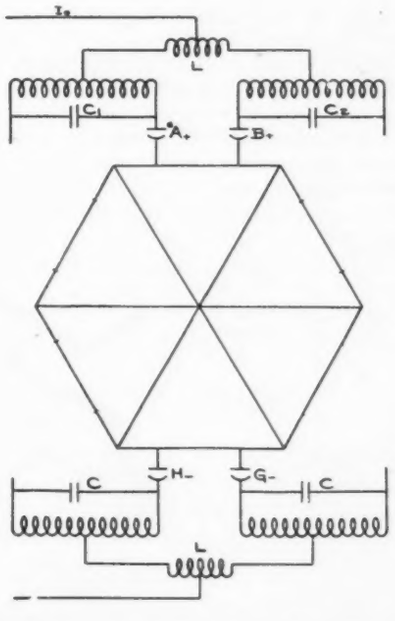
# Inverters, Rectifiers and Low-Frequency Generators

While 60 cycles has become virtually the standard frequency, it has not closed the doors to other frequencies for local usage. High-speed tools have demanded 180 cycles and now it is evident there is a definite call for low frequencies even down to 2.5 cycles. J. I. Hull of the General Electric Company described a new generator with commutator and self-excitation of its fields capable of rendering a service to which the synchronous separately excited machine is not well adapted. The field of usefulness is principally one in which constant voltage at low variable frequency rather than variable voltage at standard frequency is needed — printing presses, super-calenders for paper mills, for example.

Vibratory devices like screen shakers work best with 10 to 15 cycles per second supplied to their solenoids. Motors which have to reverse frequently can avoid the "plugging" procedure by having a supply that affords continuous changes of both frequency and voltage; this scheme can even be adapted readily to smooth transition into phase-sequence reversal to effect reversal of motor direction. These developments and potentialities have resurrected the self-excited commutator generator originally proposed by William Stanley and G. Faccioli in 1915, and now extended to practical application.

In a paper presented by H. V. Putman for M. Stone of Westinghouse it was pointed out that satisfactory parallel operation of a.c. generators is a stability problem hinging on the natural frequency of the governor relative to the natural frequency of the generator system. The proper application of damping to prevent oscillations rests on the following conclusions:

1. When the governor natural frequency exceeds the generator natural frequency, damping in the governor is necessary, and useless in the generator.
2. When the governor natural frequency is less than generator natural frequency, a damper winding is necessary, and governor damping is without point.
3. For isochronism, both generator and governor damping are necessary, and in large amounts.




**Twin-six inverter gives sine wave**

Condensers across interphase transformers aid thyratrons A, B, G, H to establish voltage proportional to the currents, thus facilitating the attainment of a sine wave of a.c. output from the d.c. input supplied to the hexagonal mesh of transformers. (Willis)

For systems using indirect governing, *i.e.*, through the use of a servomotor, such as are necessary for waterwheel and turbine generator installations, unless very rapid response servomotors are used, phenomena as discussed in this paper do not exhibit themselves.

The Bush integraph was applied to the solution of the pull-in phenomena of synchronous motors in a study conducted by four authors from the Massachusetts Institute of Technology. Their objective was to find the time and angle limits for optimum closure of the field switch in the synchronizing operation. The non-linear differential equations which represent the transients which take place while the motor strives to get into synchronism were solved by the integraph. The solution points to the desirability of controlling the time (or electrical angle) at which the d.c. field switch is closed. If this is done within predetermined limits, as may be effected with automatic synchronizing equipment, larger loads may be pulled into step, especially with high-resistance amortisseur windings and large inertia loads, than with haphazard field closing time. The authors impressed the audience as to the validity of their findings by means of a stroboscopic demonstration which exhibited the phenomena in a convincing manner.

### Rectifier development

Thyratrons and mercury rectifiers found their proponents discussing papers on these subjects by C. H. Willis and by J. Slepian and L. R. Ludwig. Third or higher harmonic voltages imposed on interphase transformers of thyratron inverters control the commutation of the respective thyratrons by voltage reversal and the consequent deionization at the cathodes.

The General Electric Company has now ready for test a 500-kva. rectifier using the F.G.41 thyratron tubes and employing harmonic commutation and the twin-six rigid transformer network, shown on this page, to give a sinusoidal alternating current. This rectifier is designed to be supplied from a 4,000-volt, three-phase, 60-cycle circuit and to operate at zero leading power factor as described above.

This apparatus will function as a synchronous condenser and may be given the same load characteristics as a rotary synchronous condenser, but without many of the complications and disadvantages of rotating machines. The rectifier operating as a condenser will lack the ability to hunt and cannot drop out of synchronism. The losses will be lower than those of a rotating synchronous condenser of equal rating.

Asked whether this scheme does not involve an inordinate amount of interphase transformer and capacitor kva. in

proportion to the rated kva. of the inverter, Professor Willis said that the auxiliary capacity was only 3 per cent for a twelve-phase inverter at 100 per cent power factor as against some 20 per cent for a six-phase inverter.

Initiating the cathode of an arc by a new "ignitron" was indicated by Messrs. Slepian and Ludwig to open wide possibilities for absolute control of the arc in mercury rectifiers. A pencil of high-resistance material carrying a small current into the surface of the mercury pool establishes a localized high-voltage gradient where the mercury and electrode join. This high gradient, obtained, however, by employing only 100 volts or so, ionizes the mercury vapor and assures the ignition of the arc at a specific time determined by the phase of the ignition voltage.

The authors were insistent that the phenomenon is quite distinct from the point contact and volatilization phenomenon first proposed in 1904 in connection with ignition of mercury vapor lamps as recalled by O. K. Marti. The latter, in a discussion read by William Arthur, said that grid control of rectifiers called for less control power than the ignitron scheme. On the other hand, Dr. Slepian called attention to the necessity of using refractory and other high temperature materials with grid control in order to insure the elimination of backfire which, until grids were devised, dominated the whole procedure in rectifier design.

Features of a 3,000-kw., 600-volt mercury-arc rectifier for the Eighth Avenue subway, described by E. H. Reid and C. C. Herskind, include water cooling, grid-controlled anodes, maximum efficiency at 70-80 deg. C. and the ability to carry 7,000 amp. continuously, 10,000 amp. for ten minutes and 16,000 amp. for one minute. The thyratron control used, they pointed out, is not confined to rectification, but can be applied to voltage-regulated d.c. power output, high-speed circuit breakers, inverters and static frequency changers.

A synchronous-mechanical rectifier-inverter with overlapping slip rings that short circuit the transformer during the commutating interval and into which two third harmonics are introduced to aid commutation (one in phase and proportional to the system voltage and the other at quadrature and proportional to the d.c. load) was described by S. S. Seyfert. It has been successful in rectifying 1,500 volts at 25 to 75 amp. and can change to inverter action in a few seconds.

### Electronic regulators and synchronizers

Controlled condenser discharge in connection with electron tubes constitute new types of voltage regulators described in a paper by F. H. Gulliksen. For d.c. generators high-vacuum tubes are used as power tubes and the regulator has a field-current regulating-range of 0.75 amp. Glow tubes are used as power tubes for the regulation of a.c. generators and afford an 8-amp. maximum of field current. The regulators have a sensitivity of 0.2 per cent and are simple and quick in response. With the quick response and high sensitivity, however, comes an inherent tendency toward instability; this is easily overcome, however, by the employment of the condenser discharge through a relatively large resistance, the drop in which, during the condenser discharge, is applied to the grid of the tube. A feature of these regulators is that they function in proportion to the rate at which the voltage is changing and not to its prevailing magnitude. This is the seat of the quick-response characteristic.

Trend toward condenser bushing potential devices with their low volt-ampere capacity has prompted the development of a low-capacity automatic synchronizing mechanism which can be given a proportional advance feature. This means that the breaker can be closed at a point in advance of actual synchronism by an amount proportional to the instantaneous difference in frequency. This again employs the condenser discharge principle.

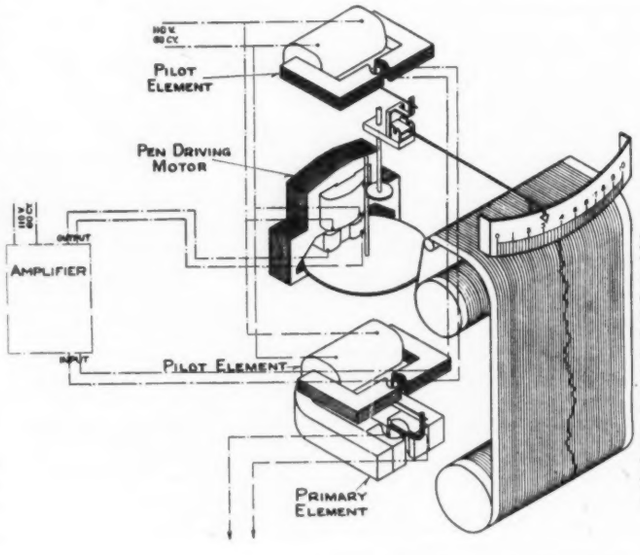
## Advances in Dielectric, Graphic and Acoustic Measurements

While indicating instruments of the microampere class are common, conventional graphic or recording instruments have not in general got below the milliampere level of sensitivity because the friction of the pen mechanism is 100 to 1,000 times as great as the jeweled bearing of the indicating meter. But a new electronic principle described by H. L. Bernarde and L. J. Lunas (Westinghouse) puts the recording meter of any sort into the 4-microwatt class of sensitivity.

The electronic recorder described consists essentially of two pilot elements the difference in voltage of which, as resulting from the different angular position of each coil in an a.c. field, is impressed on the grid of an electron tube assembly which acts as a power amplifier. The output of the amplifier is applied to an induction motor element (watt-hour meter disk type) which drives the pen and one of the pilot elements to the position where the two pilot elements balance their voltages at the grid terminals (see below).

Bridge measurements of dielectric power factor with enhanced precision and an air condenser of low capacitance were other items on the measurement program. To show the degree of progress in power factor measurement E. S. Lee said that the best that could be done in 1925 was to get a 0.002 variation in measuring a long cable's power factor of 0.005 by means of the Schering bridge. In their paper Balsbaugh and Moon expressed confidence that they could measure oil sample power factors to 0.0001 with a precision of 1 per cent. This moves the accuracy into the sixth decimal place, measuring "nearly nothing" as expressed by one discussor. Work with the bridge indicates that air condensers have absolute power factors substantially higher than $10^{-6}$.

W. B. Kouwenhoven in describing his new compressed air (ten atmos-




**Electronic recorder has high sensitivity**

Primary element may be voltmeter, wattmeter, frequency meter, etc. Its deflection moves coil in field of lower pilot element; the voltage induced in the coil is impressed on grid of amplifier tube, the output of which moves the pen and the upper pilot to the position where its voltage balances that of the lower pilot element. (Bernarde and Lunas).

phere) capacitance standard vouchsafed, however, that its capacitance was loss-free and independent of variations in voltage, frequency and temperature. The discussion of these two papers left the impression that there are still two camps which are divided on the question whether air introduces dielectric losses when used as a dielectric in standard condensers.

In another session J. B. Whitehead, in an extensive report on dielectric losses in impregnated cable paper, indicated that loss increases after impregnation were directly related to the product of viscosity and conductivity of the impregnating oil. Subsequently W. A. DelMar made some comment on the oil situation. Except as to transformer oils, the oil producers, he said, know little about the chemical and physical properties of their oils in so far as they give an index of electrical performance. Withdrawal of support from much of the current work under electrical auspices should be met by participation and independent research on the part of the oil producers if the progress of cables is not to be impeded.

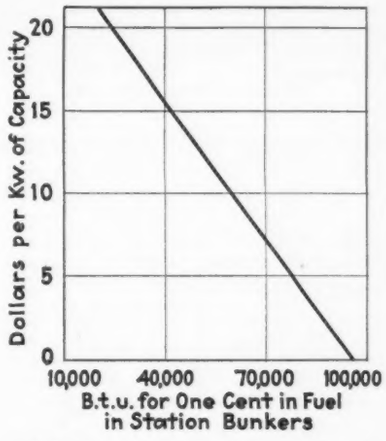
### Acoustical thresholds reconciled, but problems exist

Slow but sure progress is being made in the field of acoustical measurements, but there are still stumbling blocks to overcome in devising a metering technology which will parallel the aural mechanism and response. Dr. Harvey Fletcher of Bell Telephone Laboratories told a group that was several times as large as anticipated that it was necessary to inject into the picture a correction factor of the nature of an interference ratio in order to bring metered acoustical energy for loudness determinations into line with the ear's judgment of loudness, especially for frequencies that are close enough together to involve the same nerves in the transmission from ear to brain. Otherwise the impulses, to which the brain alone responds, will merge to result in a loudness decision that will be much at variance with the totalization of the energy components to which it appears the meter is restricted in its functioning.

One significant point brought out by Dr. Fletcher is that the threshold value for the ear (about $10^{-16}$ watts per square centimeter) is likewise close to the order of magnitude of sounds originating in the natural electronic movement in conductors over which sound is transmitted electrically. It is also of the same order of magnitude of sounds arising out of the Brownian movement in the air itself. There seems to be plenty of justification for accepting this value as a satisfactory substitute for an absolute zero or a zero founded on arbitrary energy assignments.

# High Pressures and Temperatures—a Challenge

Temperature is still more a deterrent to higher generation economies than pressure because of the effect of high temperatures upon available boiler materials. This was stated by I. E. Moultrop in a paper tracing the history of higher steam pressures and temperatures and pointing to the economies achieved. Unit cost of construction decreases with increase in pressure only if the higher pressure does not entail adoption of a different heat cycle or a radical change in design of the pressure apparatus. Dollar efficiency should take precedence over the marginal gains in thermal efficiency which are available by inching up in pressures or temperatures. Generation cost is already so low that elimination of all of it would hardly affect the cost of energy to the ultimate average consumer.




**High pressure best substantiated by low-grade or expensive fuel**

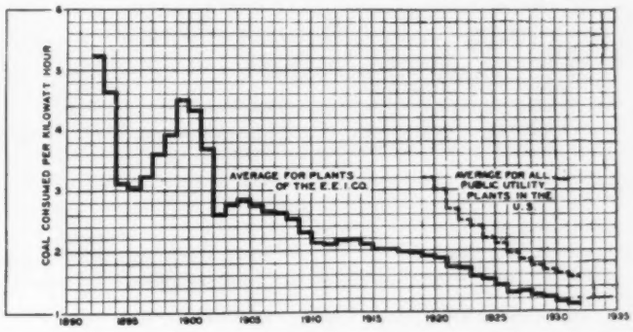
Chart shows additional capital investment justified for 1,200-lb., 750-deg. station over 400-lb., 750-deg. station. Assumptions: 3,500 kw.-hr. per year of capacity (40 per cent load factor) and fixed charges at 14 per cent. (Engle and Moultrop).

Discussion was participated in by such deans of the thermodynamic art as Messrs. Jacobus, Orrok, Potter, Scheffler, Hollister, Weigel, Knight, Monroe and Post. The series and velox boilers were shown as the trend of the times in European practice and American experimentation. The former is not new nor is the proposed unit assembly of steam generator, engine and accessories, since such units supplied the electrical requirements of the Stockholm exhibition in 1894.

Friction in the small pipes of the series boiler is a limiting factor in the forced circulation situation and this will be subjected to further study in the Purdue tests on the 3,600-lb., 830-deg. experimental set-up. But results with conventional designs in conjunction with reheat at Milwaukee show that it is not necessary to go to series design in order to attain good performance, availability and low maintenance. Experience with the large units of Brooklyn Edison which have already turned out over a billion kilowatt-hours (1.3 per cent of the total U. S. generation) have justified the strong partiality toward future installations of 200,000-kw. units at 1,200 lb. and 750 deg. without reheat, one boiler per turbine, no cross connections and no duplication of auxiliaries.

Another angle on the matter of thermal economies was brought out by G. B. Warren, who said that if all General Electric turbine sales to industrials in 1927-29 for combined power and heat service had been of 1,200-lb. design they would have represented 200,000 more of kilowatt capacity. That figure would have been 500,000 kw. if the units could have embraced the mercury cycle. The industrials of the country constitute a heat sump into which the rejected heat of power plants can be pumped (instead of throwing that heat into the river) and at a cost about one-third the heat consumption charged to electrical generation.

**Boston Edison and all U. S. utilities have steadily reduced coal consumption**



# An Unusual Electrification in H

By ROBERT F. STOCKAR

*Zurich, Switzerland*

ELECTRIC train service has recently been inaugurated on the Budapest-Komarom section of the Hungarian State Railway's double-track main line running to Hegyeshalom on the Austrian border. The locomotives have a tractive effort of 15,200 to 23,300 lb., depending on whether passenger or freight, and acceleration from 0 to 45 miles per hour in six minutes for passenger trains (660 tons) and 0 to 9.8 miles per hour in $2\frac{3}{4}$ minutes for freight (1,540 tons) on 0.67 per cent grades with 1,300-ft. curves. Top speeds on tangents with 0.1 per cent grades are 62 and 38.3 miles per hour for the two classes. The contact system is energized at 16,000 volts, single phase.

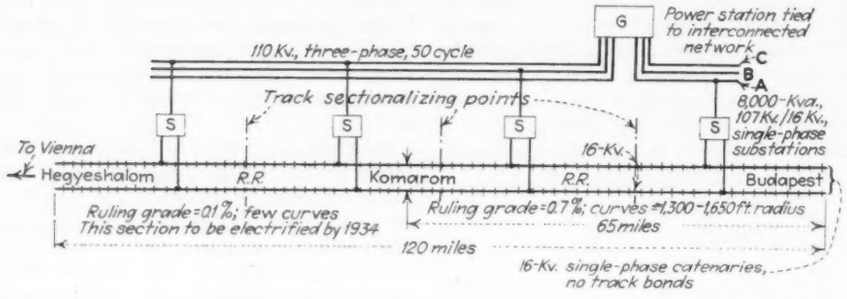
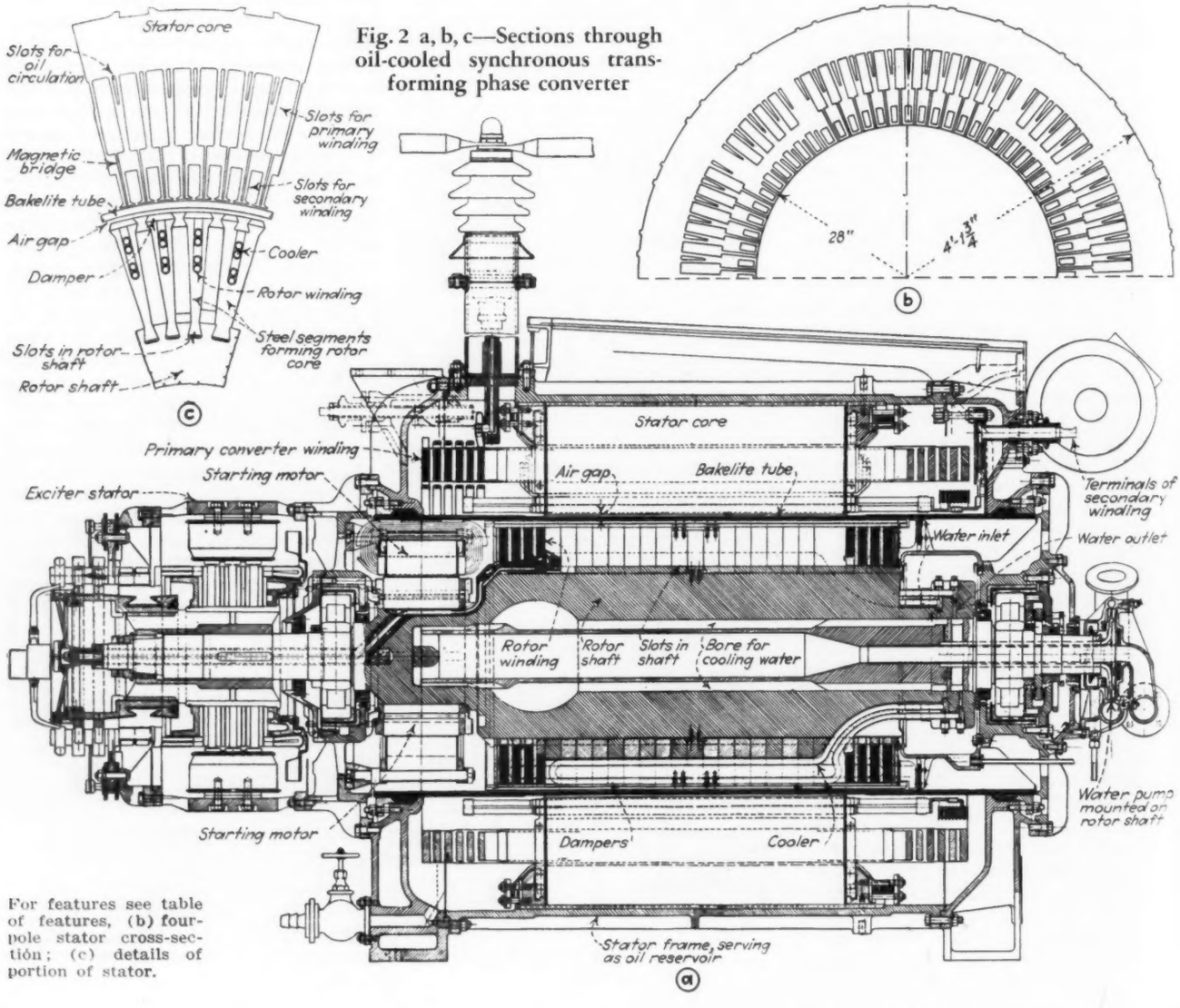


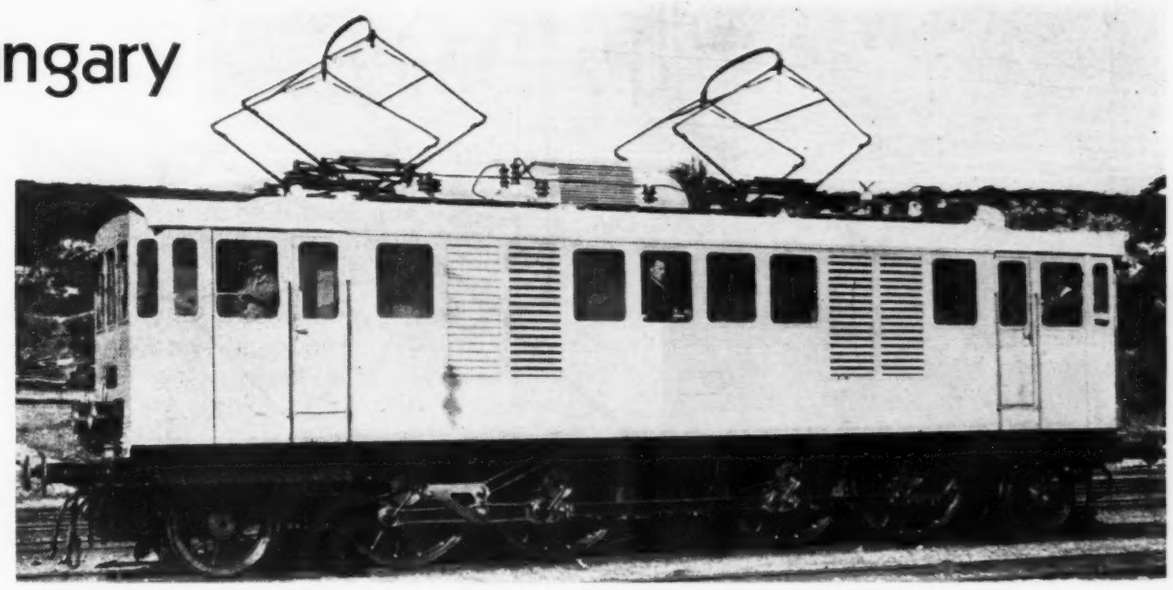

**Fig. 1—Power supply and features of new Hungarian railroad electrification**

**Fig. 2 a, b, c—Sections through oil-cooled synchronous transforming phase converter**




For features see table of features, (b) four-pole stator cross-section; (c) details of portion of stator.

# Hungary



The unusual features of this electrification are chiefly in the oil-cooled synchronous transforming converters and multi-speed motors, details of which are illustrated here and explained in the table of features. The latter also includes information on the transmission systems, substations, contact systems, locomotives, traffic conditions and cost of electrification.

*(For other illustrations see page 168)*

## *Features of Hungarian State Railway Electrification*

**Transmission System**—Fed from interconnected network; nearest power house 32 miles from Budapest.

Two two-circuit, three-phase, 50-cycle, 110-kv. lines—grounded-neutral copper-cadmium (80.6 sq.mm.) east 44 miles to Budapest; steel-aluminum (86.4 sq.mm.) west 56 miles to Horvatkiml substation.

Spans—800 ft.; ground wire (58 sq.mm.); seven-disk, 10-in. insulators.

**Substations**—four, each serving about 30 miles of track.

Each equipped with two oil-cooled one-phase transformer banks, each rated at 4,000 kva., 107 kv./16 kv.

Fed from separate phases, so that with traffic conditions load is about equally divided.

**Contact System**—325 track-miles, including side tracks.

Simple catenary—Messenger—Average span 250 ft.; steel or bronze 50 sq.mm.; round bronze hangers every 26 ft.

Conductors—Hard-drawn copper; 100 sq.mm. on main line; 65 sq.mm. on side tracks; 12,000 lb. per sq.in. tension maintained by weights every mile; double-track catenaries electrically and mechanically separated.

Track bonds—None; no track signal circuits.

| **Locomotives** | Passenger and Express | Freight |
|---|---|---|
| Type | 1 D 1 (2-8-2) | F (0-12-0) |
| Number of driving motors | 1 | 1 |
| Weight (tons)—total | 103.4 | 103.4 |
| on drivers | 72.8 | 103.4 |
| per axle | 19.5 | 19.5 |
| Horsepower (continuous) | 2,200 | 2,200 |
| Tractive effort (continuous) lb. | 15,200 | 23,300 |
| Train weight (tons) | 660 | 1,540 |
| Acceleration rate on 0.67 per cent grade and 1,300-ft. curve | 0-45 m.p.h. in 6 minutes | 0-9.8 m.p.h. in2¾ minutes |
| Speed on tangent with 0.1 per cent grade (maximum miles per hour) | 62 | 38.3 |

**Synchronous Transforming Phase Converters**—16,000-volt, one-phase/1,000-volt multi-phase 1,500-r.p.m.; induction motor for starting; direct-connected exciter.

**Fed directly from pantograph** through oil circuit breaker.

**Two separate windings on stator**—16,000-volt, single-phase primary occupies 2/3 of pole pitch; 1,000-volt, polyphase secondary winding occupies whole pole pitch and feeds motors; separate rows of slots for each winding; secondary in partly closed slots next to air gap; primary in closed slots further from air gap; magnetic bridges between slots designed to give 90 to 98 per cent leading power factor on primary side and high efficiency on motor side; short-circuit current no higher than full-load current.

**Oil-cooled stator**; case filled with transformer oil; oil-cooled by radiators on outside of locomotives; to increase radiation, reduce size and hold axle weight to 19.5 tons.

**Water-cooled rotor**; copper pipes in rotor slots through which water is forced by centrifugal pump on rotor shaft; radiator for cooling water; rotor separated from oil by bakelite cylinder extending through air gap and fastened oil tight against end walls of oil case.

**Motors**—Two windings on rotor giving different speeds:

| | Poles | Phases | R.P.M. | Miles per Hour Passenger | Miles per Hour Freight |
|---|---|---|---|---|---|
| Inside winding | 18 | 2 | 333 | 62.2 | 42.6 |
| | 24 | 6 | 250 | 46.7 | 32.0 |
| Outside winding | 36 | 3 | 167 | 31.1 | 21.3 |
| | 72 | 3 | 83 | 15.6 | 10.6 |

**Water resistor** for starting with wattmeter-type regulator.

**Drive**—Triangular articulation permitting vertical play of main-drive wheels; other drive wheels connected to main-drive wheels by coupling rods.

**Traffic Conditions**—36 locomotives will be needed for complete electrification:

Two (1-D-1) and two type F ordered first; others to be decided later.

Ruling grade on Budapest-Komarom section = 0.7 per cent.

Ruling curves on Budapest-Komarom section = 1,300-1,650 ft. radius.

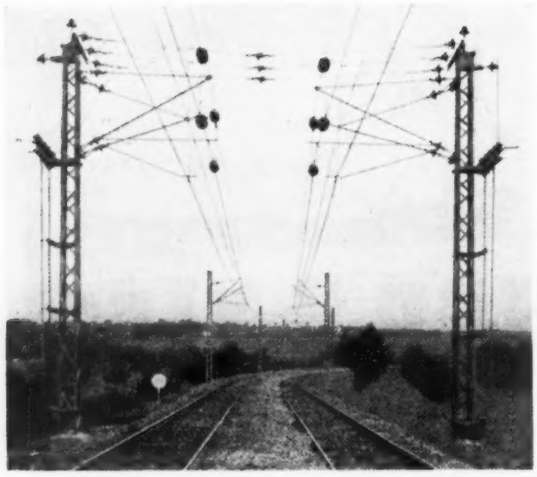
Ruling grade on Komarom-Hegyeshalom section = 0.1 per cent.

Ruling curves on Komarom-Hegyeshalom section few and long radius.

Traffic (gross ton-mile per year)—Passenger and express, 580,000; freight, 380,000; total, 960,000.

Parallel communication circuits in cable; future circuits to be underground.

**Cost of Electrification**—Total, excluding power house = $8,540,000. 75 per cent for substations, overhead circuits and locomotives; 12½ per cent for changing communication circuits; 4½ per cent for repair shops and depots; 8 per cent for remainder.



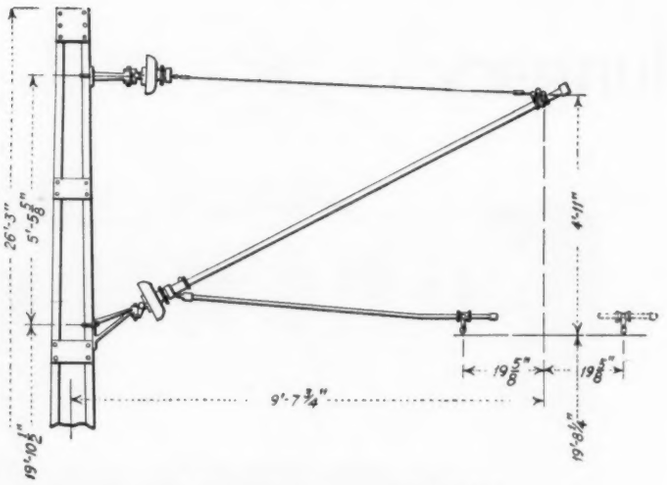



**Fig. 3 a and b—Phase-sectionalization on catenary, and standard catenary suspension**

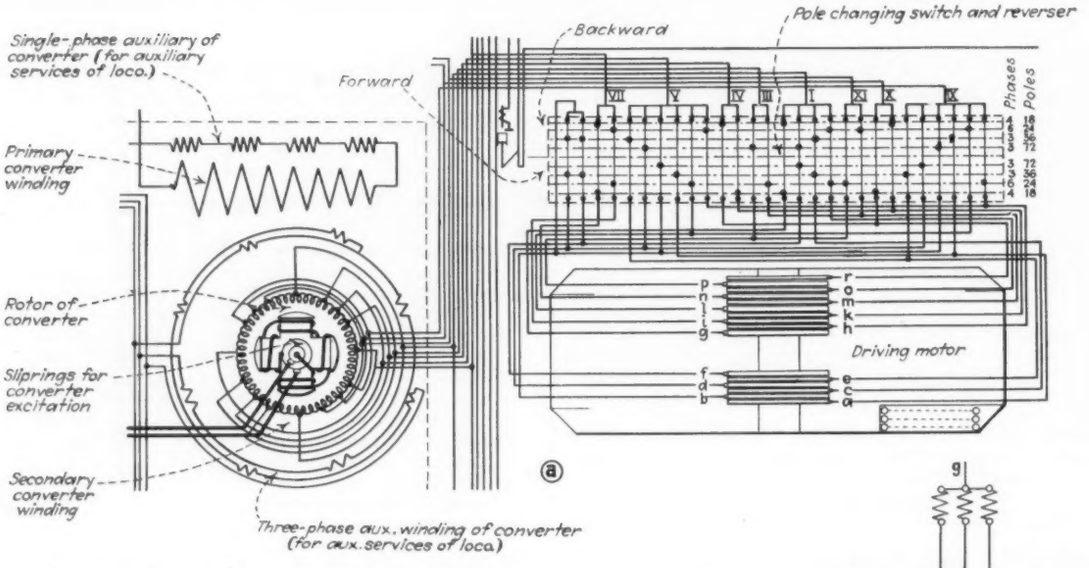
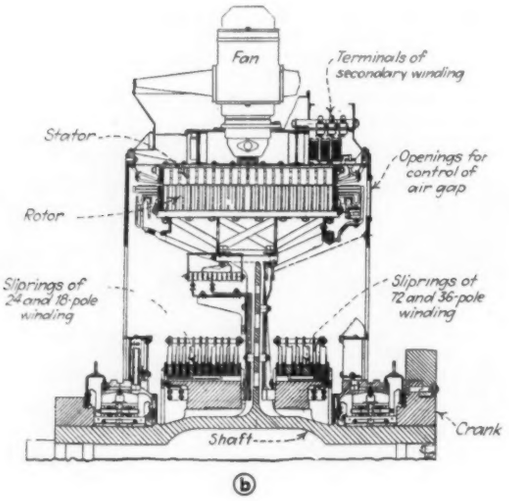
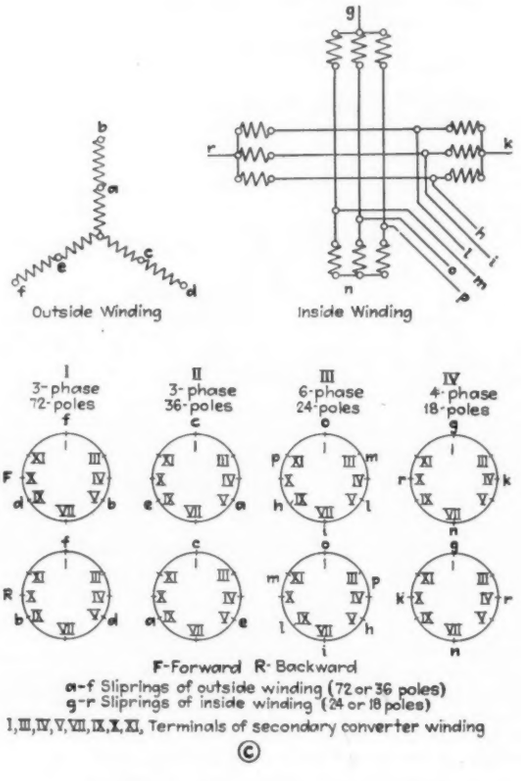



**Fig. 4 a, b, c—Converter-motor connections, section through multispeed motor and connections of motor windings**

Switching facilities between converter and motor not only permit changing phases and number of poles but also reverse motor.





Outside Winding
Inside Winding
I 3-phase 72-poles
II 3-phase 36-poles
III 6-phase 24-poles
IV 4-phase 18-poles
F-Forward R-Backward
a-f Sliprings of outside winding (72 or 36 poles)
g-r Sliprings of inside winding (24 or 18 poles)
I, II, III, IV, V, VI, VII, IX, X, XI, Terminals of secondary converter winding
ⓒ

# Speed in Customer Billing

**Toledo Edison more than doubles bill production per operator, cuts errors two-thirds and reduces cost per bill with wage incentive plan**

INCENTIVE is the mainspring of human performance. And when incentive is allied with proper tools for the job then the result may be astonishing. One billing-machine operator in the Toledo Edison Company can, and does consistently, produce from 52,000 to 54,000 customer bills per month. The production of bills in the department in March, 1932, was 103,755, the full-time work of 2.4 operators, an average of more than 43,000 bills per operator. The error percentage in this month was 0.151. The cost per bill was 0.396 cent for billing operator labor. In October, 1929, 98,945 bills were produced with 4.8 operators full time, an average of less than 21,000 per operator, with errors of 0.421 per cent and at a cost of 0.677 cent per bill. In less than 2½ years bill production doubled, operators were reduced to one-half as many, errors were decreased nearly two-thirds and operator labor cost per bill was practically cut in half. How was it done? Incentive plus modern billing equipment.

The modern billing system was installed in 1926. During the three years until the incentive plan was inaugurated, late in 1929, the modern equipment had adequately proved its great superiority in production and economy over the previous method of manual billing. That was spectacular enough and it did not seem probable that it would, or could, be greatly improved upon. But, as appears from the preceding paragraph, the wage incentive plan did exactly that.

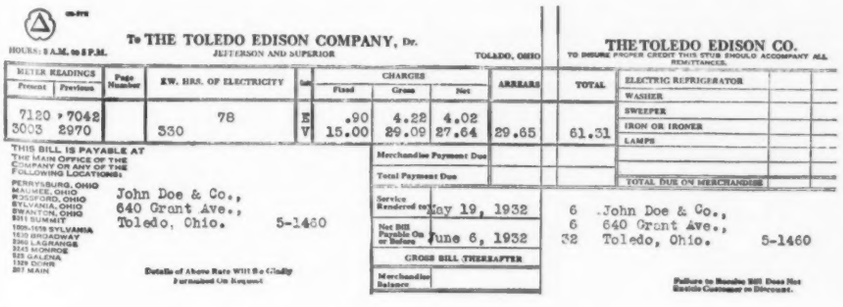
But before discussing this plan and its operation, let us get the picture of the billing system and its equipment. The billing machines write the bills and make copies of each on register sheets on which 36 customers' names have been addressographed. The billing machine operator copies last and previous to last meter readings and their difference from the meter book and extends the rate quantities and money sums on the bills. Most of the accounts are billed from prepared billing charts, but for some customers whose kilowatt demands exceed the minimums as stated in the various rate schedules the bills must be calculated by the operator. All bills of the Toledo Edison Company, the Lake Shore Power Company and the Toledo Edison Company of Michigan, except for large power customers on primary and special rates, are produced on the machines.

Two clerks are required for cash postings, one for balancing and one posts changes and new services in the meter readers' books. A total of sixteen clerks handle all billing, revenue analysis, cash posting, service order posting, balancing, and handling transfers, final bills, etc. In the addressograph department are three clerks, who in addition to bills also address payroll checks and sheets, dividend checks and sales promotion material used in merchandising activities. In this large amount of addressing work the preparation of the 36 name customers' register sheets for the billing machines is not an important cost increase item.

### Study for wage incentive plan

In the study on which the wage incentive plan was based billings were divided into four classes. The division was not made in particular reference to types of rates, but simply in regard to the time required to produce different kinds of bills. However, the billing classes do in a measure coincide with rate types in that the classes used in Table I cover roughly residential, commercial and small and large power in the order named. From the register sheets of August, 1929, the data of Table I were obtained. This table shows total billings and number and percentage of each class in the total. The average hourly billings by experienced operators from March 1 to August 31, 1929, varied by individuals from 107 to 174. From the data on operator performance it seemed reasonable to set 150 bills per hour as the production standard on which to base the incentive plan. A time check (Table II) showed the time spent on each of the four classes when 150 bills of average proportion between classes were produced.

By comparison with salaries paid other employees a fair wage rate was set up for a standard production of 150 bills per hour. For the purpose of explaining the incentive plan the wage rate is taken as $100 per month. This is not the rate paid in Toledo, but it furnishes a decimal base which allows the figures of the study to be applied to any wage rate by simple multiplication. At $100 per month for the average month of 192 working hours the rate per minute is 0.86806 cent. This amount, multiplied by the number of minutes on each class of bill in the time study (Table II) for the production of 150 bills per hour and divided by the



To THE TOLEDO EDISON COMPANY, Dr.
JEFFERSON AND SUPERIOR — TOLEDO, OHIO
HOURS: 8 A.M. to 5 P.M.

THE TOLEDO EDISON CO.
TO INSURE PROPER CREDIT THIS STUB SHOULD ACCOMPANY ALL REMITTANCES.

| METER READINGS Present | Previous | Page Number | KW. HRS. OF ELECTRICITY | Sub | CHARGES Fixed | Gross | Net | ARREARS | TOTAL |
|---|---|---|---|---|---|---|---|---|---|
| 7120 | 7042 | | 78 | E | .90 | 4.22 | 4.02 | | |
| 3003 | 2970 | | 330 | V | 15.00 | 29.09 | 27.64 | 29.65 | 61.31 |

ELECTRIC REFRIGERATOR
WASHER
SWEEPER
IRON OR IRONER
LAMPS
TOTAL DUE ON MERCHANDISE

THIS BILL IS PAYABLE AT THE MAIN OFFICE OF THE COMPANY OR ANY OF THE FOLLOWING LOCATIONS:
PERRYSBURG, OHIO
MAUMEE, OHIO
ROSSFORD, OHIO
SYLVANIA, OHIO
SWANTON, OHIO
3011 SUMMIT
1005-1015 SYLVANIA
1610 BROADWAY
2960 LAGRANGE
3545 MONROE
525 GALENA
1329 DOWN
267 MAIN

John Doe & Co.,
640 Grant Ave.,
Toledo, Ohio. 5-1460

Merchandise Payment Due
Total Payment Due
Service Rendered to May 19, 1932
Net Bill Payable On or Before June 6, 1932
GROSS BILL THEREAFTER
Merchandise Balance

6 John Doe & Co.,
6 640 Grant Ave.,
32 Toledo, Ohio. 5-1460

Details of Above Rate Will Be Gladly Furnished On Request

Failure to Receive Bill Does Not Entitle Customer to Discount.

**Bill form of Toledo Edison Company**

This particular bill has sixteen billing machine entries. The minimum number of entries is seven and the average is about nine. Yet average production per operator is about 43,000 bills per month.

***Table I—Classes and Average Proportions of Billings***

| Class* of Bill | Per Cent of Total | Number per Class |
|---|---|---|
| 1 | 70.43 | 75,047 |
| 2 | 26.24 | 27,965 |
| 3 | 1.92 | 2,045 |
| 4 | 1.41 | 1,505 |
| Totals..... | 100.00 | 106,562 |

***Table II—Time Study of Bill Production***

| Class* of Bill | Number of Billings | Number of Minutes |
|---|---|---|
| 1 | 105.6 | 28.5 |
| 2 | 39.4 | 26.0 |
| 3 | 2.9 | 2.8 |
| 4 | 2.1 | 2.7 |
| Totals..... | 150.0 | 60.0 |

***Table III—Billing Labor Costs***

| Class* of Bill | Operator's Earnings per Hour | Rate per Bill |
|---|---|---|
| 1 | $0.2478 | $0.002343 |
| 2 | 0.2257 | 0.005728 |
| 3 | 0.02425 | 0.008333 |

*Roughly residential, commercial, small and large power users respectively (see text).

number of bills in each class, leads to unit labor rates per bill (Table III) These rates, applied to bill production per operator, assure invariable compensation irrespective of the proportion of, and time on, bills of different classes. That is to say, the operator earns the same amount per hour whether the hour is given to one or another class of bill or is divided in any proportion between the four classes.

The average number of errors per month per operator over the six-month period covered by the study was approximately 80, the lowest individual average being 54. It was believed that as good, or better, results could be obtained by setting a standard of accuracy to be required of operators for retention of their positions as by exacting a cash penalty per error in the incentive plan. The limit of permitted errors per month was fixed at 0.2 per cent. This error requirement is not imposed on operators who have had less than three months' experience.

Beginning operators do not come under the provisions of the incentive plan until they have had three months' experience. During these months the pay is 62.5 per cent of the base monthly rate for standard production of 150 bills per hour. From average performances it was concluded that 65 bills per hour would be a fair requirement in the beginner's first month. This is 43.3 per cent of standard production. It seemed reasonable that an operator of adequate ability should reach the standard efficiency in six months and that the difference of 56.7 per cent between beginning efficiency and standard production should be decreased equally over the remaining five months. A beginner who cannot maintain this rate of improvement during the first three months is not likely to develop into a competent operator. Relief operators are on regular salary, but are required to maintain standard production when billing.

At the time this plan was started it was believed that one less operator would be required as well as that the load factor on billing machines in use would be raised. It was felt that the operators would have to increase their production materially to qualify under the requirements, but that the incentive of increased earnings would bring this about. How well these expectations were fulfilled was recited in the opening paragraph of this article: number of operators decreased one-half and production more than doubled.

Remarkably consistent performance was obtained from one of the Toledo Edison operators under the incentive plan. In one month this operator reached an average hourly production of 273 bills with an error record of only 0.0215 per cent. From month to month she consistently averages better than 240 bills per hour. Here is a mark for billing machine operators to shoot at not only in the Toledo Edison Company but all over.

***Table IV—Bill Production in Toledo Edison Company***

| | Total Billings | Required Billing Hours | Average Billings per Hour | Number of Operators | Errors | Cost per Bill Labor Only |
|---|---|---|---|---|---|---|
| 1929 | | | | | | |
| October ..... | 98,945 | 844.9 | 117 | 4.8 | 417 | $0.00677 |
| Wage incentive plan started | | | | | | |
| 1929 | | | | | | |
| November..... | 103,397 | 660.5 | 145 | 3.6 | 434 | 0.0047 |
| December..... | 106,210 | 805.5 | 131 | 4.3 | 397 | 0.00524 |
| 1930 | | | | | | |
| January..... | 119,891 | 869.3 | 126 | 4.5 | 494 | 0.00442 |
| February..... | 104,136 | 638.7 | 163 | 3.6 | 388 | 0.00445 |
| March..... | 104,215 | 580.6 | 179 | 3.0 | 380 | 0.00411 |
| April..... | 107,447 | 588.4 | 182 | 3.0 | 286 | 0.00404 |
| May.. ..... | 107,513 | 583.4 | 161 | 3.8 | 328 | 0.0041 |
| June..... | 108,262 | 577.9 | 187 | 3.0 | 301 | 0.00406 |
| July..... | 107,578 | 583.5 | 174 | 3.0 | 287 | 0.00409 |
| August ..... | 107,447 | 603.5 | 178 | 3.2 | 298 | 0.0046 |
| September..... | 104,862 | 535.3 | 196 | 2.9 | 222 | 0.0045 |
| October..... | 112,341 | 594.5 | 189 | 2.9 | 250 | 0.00399 |
| November..... | 105,054 | 548.4 | 192 | 3.1 | 186 | 0.00425 |
| December..... | 109,735 | 567.6 | 193 | 3.0 | 227 | 0.00405 |
| 1931 | | | | | | |
| January..... | 106,762 | 540.4 | 198 | 2.8 | 234 | 0.00408 |
| February..... | 106,231 | 528.0 | 201 | 3.0 | 166 | 0.00404 |
| March..... | 106,164 | 514.9 | 206 | 2.6 | 161 | 0.00409 |
| April..... | 106,878 | 545.6 | 196 | 2.8 | 178 | 0.00402 |
| May..... | 105,787 | 571.0 | 185 | 3.1 | 316 | 0.00399 |
| June..... | 107,580 | 581.5 | 185 | 3.0 | 310 | 0.00397 |
| July..... | 111,106 | 572.3 | 194 | 2.9 | 310 | 0.00406 |
| August ..... | 102,892 | 518.7 | 198 | 2.7 | 261 | 0.00457 |
| September..... | 105,916 | 567.6 | 187 | 3.0 | 301 | 0.00466 |
| October..... | 110,661 | 575.4 | 192 | 2.9 | 224 | 0.00405 |
| November..... | 100,612 | 511.3 | 197 | 2.9 | 210 | 0.00401 |
| December..... | 110,192 | 571.7 | 193 | 3.0 | 230 | 0.00401 |
| 1932 | | | | | | |
| January..... | 99,929 | 530.1 | 189 | 2.9 | 217 | 0.00403 |
| February..... | 103,311 | 519.7 | 199 | 2.8 | 179 | 0.00421 |
| March..... | 103,755 | 497.9 | 208 | 2.4 | 157 | 0.00396 |

▼

# Locate Arresters Close to Protected Apparatus

By W. J. RUDGE, JR.

*Lightning Arrester Engineering Division, General Electric Company, Pittsfield, Mass.*

Field experience and studies of lightning voltages with cathode-ray oscillographs have shown that arresters should be located close to the protected apparatus, including distribution transformers as well as high-voltage transmission systems. A wave rising as fast as 1,000,000 volts per microsecond gives a gradient along the conductor of 1,000 volts per foot. The velocity of a wave on an overhead line is 186,000 miles per second, or 1,000 feet per microsecond. From the above, it follows that one point on a conductor may be at ground potential, while 1,000 ft. away 1,000,000 volts may exist. At a point removed from the arrester the voltage difference will be greater for steep waves applied and longer separations.

In transmission practice involving large stations and high transmission voltages the physical arrangement of the apparatus may make it difficult to place the arrester directly adjacent to the transformer or other apparatus. Electrostatic capacity of the apparatus in such stations is effective in sloping off the wave front and reducing the magnitude of the applied wave, but the best engineering practice neglects the additional benefits from the capacity effects and places its dependence on the proper location of the arrester.

Where a co-ordination gap is installed to establish a level of insulation for design of station apparatus which is independent of line insulation level, the recommended practice is to place a "Thyrite" arrester within 50 circuit-feet of both co-ordinated gap and apparatus to be protected for circuit voltages up to and including 69 kv., and within 100 circuit-feet for circuit voltages above 69 kv. Location of the arrester with respect to the gap is important to protect the gap and to avoid unnecessary circuit outages. Fifty and 100 ft. were taken as arbitrary limits because it was felt that reflections of arrester or gap voltages from these distances would not be serious in the majority of installations.

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# Transmission Towers Raised 25 Ft. Without Removing Copper

By C. H. ALLEN
*Construction Department*
*Los Angeles Bureau of Power and Light*

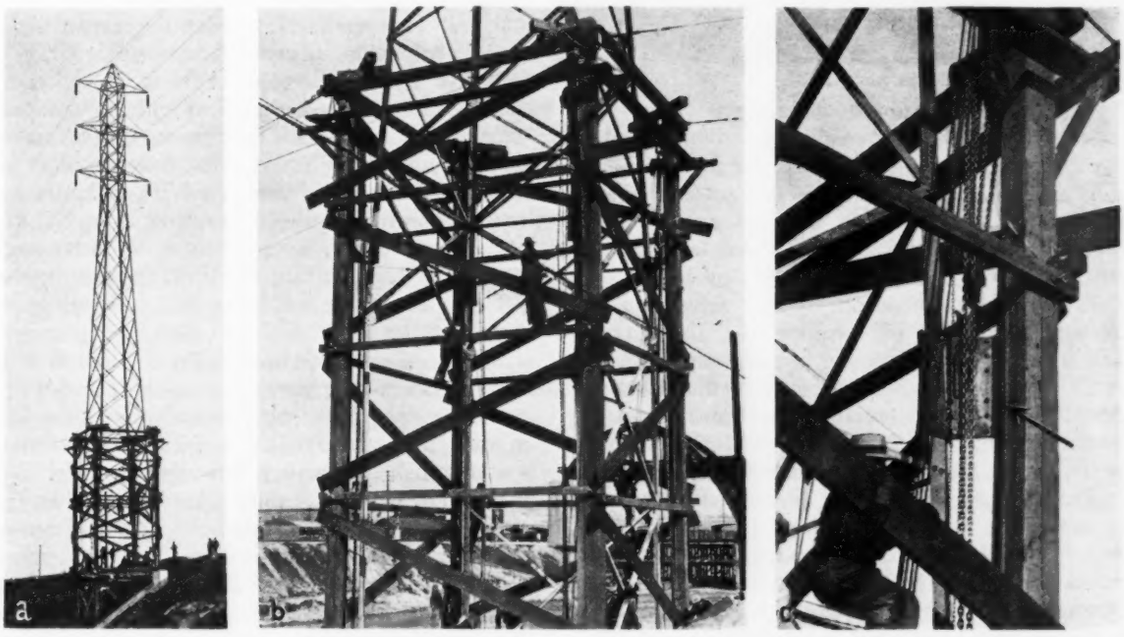
Structures built near transmission lines often require that additional clearance be provided to comply with safety requirements. A recent example of providing such clearance on a 132-kv. transmission line of the city of Los Angeles Bureau of Power and Light illustrates the method which has proved very satisfactory for raising steel transmission towers.

Additional clearance was necessary due to the construction of a steel bridge passing across the transmission line right-of-way of such a height as to necessitate raising the line approximately 25 ft. It was decided to raise the towers on either side of the bridge, increasing their height by the above amount without disturbing the line. To accomplish this a heavy wood scaffolding was constructed around the outside of the towers, the main members being 12x12 timbers, placed so that their inside corners were perpendicular to and parallel with the legs of the tower itself.

Four guides were constructed, each consisting of two pieces of angle iron approximately 18 in. long and a steel plate of this length and 10 in. wide. These pieces were bolted together so that the angles formed a 90-deg. "V" at the outer end of the plate, the vertex of this angle being the center line of the guide.

One of these pieces was bolted to each of the four legs of the tower so that the outer angle fitted snugly against the corner of the timber which was to act as a guide during the ascent of the tower. Five-ton gear blocks were then mounted on each corner and attached to the guides. Graduated steel tapes were hung from each corner and the tower was raised to its new position, the guides keeping the structure steady and the tapes offering a means of checking the level of the structure during the process. When raised to its new position the new steel members were bolted into position and the job was complete.

The entire operation was accomplished in a relatively short time. Although guys were used on the scaffolding, no guys were needed on the tower itself during this operation, which was started at 6 a.m. to take advantage of the early morning calm and eliminate the hazard of wind strains.

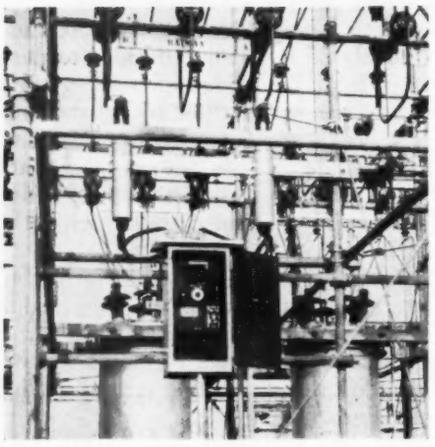



(a) Scaffolding surrounded the base of the transmission tower, which was raised 25 ft. to accommodate clearance required by the construction of a bridge near by.
(b) Close-up of the scaffolding showing the chain blocks and general position of the timbers acting as guides.
(c) Detail of the guide construction showing how the angle iron extremity of the guides fitted into a corner of the timbers. This guide shows the dual purpose of maintaining equilibrium and providing a point to apply the lifting force as shown by the rigging of the chain block hoist.

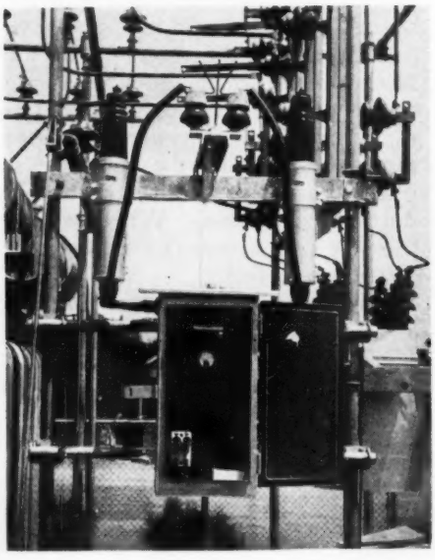
# Remote Alarms by Carrier Current Over Distribution Circuits

By F. B. DOOLITTLE

*Radio Engineer Southern California Edison Company, Ltd., Los Angeles, Calif.*



**Carrier-current alarm receiver installation**



**Transmitter showing coupling capacitors**

WHERE it is desirable to obtain one or more remote indications for reclosing circuit breakers or other apparatus at unattended distribution substations and communication lines are not available or the cost of building or leasing them is excessive, the desired result may be accomplished by simple equipment that transmits the signal over the 11-kv. or 16-kv. lines by carrier current. The accompanying schematic diagram shows the method of coupling the alarm transmitter and receiver to the power system and indicates the power supply and control wiring at each station.

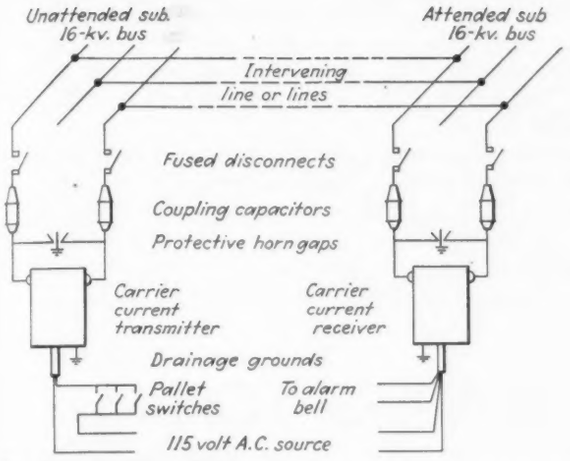
The coupling capacitors employed are 0.004 mfd. for 16 kv. and are used on either 11-kv. or 16-kv. circuits. Drainage coils are located in the cabinet inclosing the carrier apparatus, one coil being connected from each capacitor to ground. The purpose of the drainage coils is to limit the voltage from the carrier equipment to ground to a low value by providing a low impedance path at commercial frequency. As a further protective measure a horn gap to ground is connected to the low voltage side of each capacitor.

The carrier-current transmitter is extremely simple, using only one 7½-watt tube. The tube is connected to a self-rectifying Colpitts oscillator circuit. The frequency of the oscillator may be set between 50 and 100 kilocycles by taps on the oscillator inductance, which permits the use of various numbers of turns. The oscillator output is transferred to the line-tuning coil through a coupling coil, which is also variable by taps. The circuit formed by the line and the capacitors is resonated by selecting the taps on the line-tuning coil which give maximum carrier-current output. Each transmitter is equipped with a thermocouple milliammeter which indicates the carrier-current output. All of the voltages required for the operation of the vacuum tube are alternating current supplied from a transformer, no batteries being used. Thus the transmitter operates only on alternate half cycles, being those on which the tube plate potential is positive with respect to the filament. When operating, the transmitter requires a maximum of 50 watts at 90 per cent power factor from the 115-volt a.c. supply.

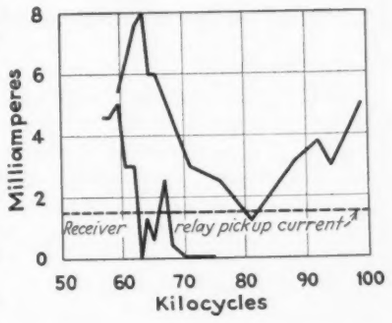
Likewise the receiver, consisting of an untuned primary coil connected to the capacitors, is simple. This primary coil is inductively coupled to a secondary coil which is tuned by a variable condenser. The one tube used is connected as a biased power detector. The coil of a sensitive telephone type relay is connected in the detector plate circuit and the contacts of this relay close the alarm circuit. The relay is provided with both normal and back contacts so that the alarm may be operated either when a carrier-current signal is being received or at such times as there is no signal. Thus the alarm systems can be used as either "open circuit" or "closed circuit." With the "open circuit" alarm a signal is transmitted only at such times as an alarm is desired and possesses the advantage of less maintenance due to longer tube life of the transmitter tube. If the "closed circuit" connection is used the signal is transmitted continuously except during the time an alarm is desired and has the advantage of being self-indicating in case of trouble in the alarm system.

Since a single communication channel at a given carrier frequency only uses alternate half cycles of the commercial supply frequency, two channels can be provided on a single-carrier frequency without interference. This is accomplished by using two receiver tubes so connected to the plate-voltage supply transformer that their plates will be positive on alternate half cycles. Then one of the receivers may be actuated by supplying energy to the transmitter in the normal direction and the other receiver will respond to the same transmitter when the 115-volt alternating-current leads supplying the transmitter are reversed.

High-frequency transmission over distribution lines depends upon so many different factors that the char-




**Carrier current alarm system and coupling to power circuits**




**By measuring signal strength under different conditions the optimum frequency may be chosen**

**In this case 59 kilocycles was adopted.**

acteristics at a given frequency are not readily predictable. However, with a relatively simple system of lines it is usually possible to find, by trial, one or more carrier frequencies at which satisfactory transmission can be obtained. Transmission through a network of distribution lines is rather doubtful and is materially affected by switching of lines involved in the network. Of course a clear carrier-frequency channel through a network can be provided by sufficient use of tuned traps in series with the branch circuits, but the cost of a number of traps for this purpose is usually prohibitive.

Each particular installation requires a series of tests to determine the best carrier frequency under different combinations of lines. The accompanying curves illustrate this point. Under one set of conditions 63 kilocycles gave maximum signal, but under other conditions of lines signal strength was a minimum at this frequency. Accordingly, 59 kilocycles was chosen as optimum frequency for both conditions.

Carrier-current receivers are actuated by high-frequency waves on the distribution lines if they are of the proper frequency, regardless of how they are produced. For this reason the alarm bells may be sounded by high frequencies induced by switching surges in the system to which the alarm is connected or in other closely coupled systems. The alarm is also actuated by surges induced by lightning. These indications are of very brief duration and are therefore easily distinguished from actual alarms. In one case an arcing ground on an 11-kv. circuit brought in a continuous alarm.

Six carrier-current alarm systems have been in service a total of 26 months. In this time they have responded to 217 surges caused by switching and lightning. They have functioned correctly on 39 test operations and have given 66 correct alarms on switch kick-outs. There have been 29 false alarms, ten of which were due to a weak tube in one of the systems which is operated as a "closed circuit" alarm. Six more of the false operations are chargeable to this one system which is connected to a distribution network and gives a very weak signal under normal conditions. Any switching change from the normal brings in an alarm in this case. The remaining thirteen false alarms probably can be accounted for by the operator mistaking the momentary bell caused by a surge on the line for an actual alarm. This mistake is easily made with automatic reclosing switches, if the operator does not hear the bell to judge the time it rings and only notices the target on his annunciator.

The cost of a single alarm system installed on a 16-kv. circuit is about $1,500. If two alarms operate into the same station, so that a double receiver can be used, the cost per alarm system is reduced to about $1,200 installed. The equipment was developed by the General Electric Company at the request of the Southern California Edison Company, Ltd.

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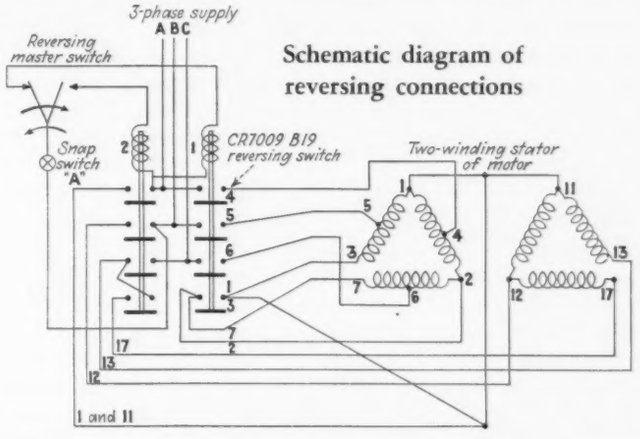
# Utilizing Multi-speed A.C. Motor on Reversing Table Drive

In a New England manufacturing plant it was necessary in processing material to reverse a machine table and return to the starting point at three times the speed employed in cutting. It was undesirable to provide direct-current service, and economy dictated the use of a standard three-phase squirrel-cage motor with conventional control equipment if possible. The problem was solved by providing a reversing master switch actuated




**Schematic diagram of reversing connections**

by the table travel and connecting it with a General Electric type "CR 7009 B 19" solenoid type reversing switch, from which taps were run to the motor as shown. Connections are shown for a 2-hp. constant-output motor run at 600 r.p.m. in forward travel and a speed of 1,800 revolutions in reverse.

When the snap switch *A* is closed, assuming that the master switch actuated by the table travel is closed at the left-hand side, the solenoid coil No. 1 is energized and the upward movement of the plunger makes contacts which cause the motor to rotate at 600 r.p.m. in forward direction. The table is driven through a bull-and-rack gear combination. Upon reaching the end of its travel the table throws the reversing master switch to break

the circuit through solenoid No. 1 and close it through solenoid No. 2. The plunger contacts of No. 1 open and those of No. 2 close, causing the motor to run at 1,800 r.p.m. in the opposite direction. The scheme is applicable to a wide variety of uses in smaller sizes of integral horsepower motors.

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# Meter Readers Contribute to Consumption Analysis

By P. J. DISHNER

*Formerly Director Public Utilities, High Point, N. C.*

One way to get a maximum of information at a minimum of expense is to use meter readers' tabulations of monthly consumption of various kinds of customers in various blocks of usage. This information is then available daily to show the effect of advertising programs and new inducement rates and to point the way to possible advantageous changes in rate structures. The method was adopted in High Point largely because the city rate required two meters for many residential customers and was conducive to errors in meter reading and billing. The objective was to reduce these errors and at the same time disclose what kind of single rate would be a good substitute for the double residential rate in vogue. Of course the ultimate object was to find a true promotional rate to encourage wider use of household appliances.

Metermen are given a daily analysis sheet with groups of columns headed "Domestic Lighting," "Domestic Power," "Commercial Lighting," "Commercial Power," "Signs," etc., covering the usages to which the analysis is to be applied. Each classification is subdivided into columns covering blocks of consumption, such as 0–21, 21–40, 41–60, etc., with several columns provided for the smallest blocks into which the largest numbers of customers fall.

At the end of the day's reading the meter readers transcribe the consumption from the reading sheets to this form. They can check the accuracy of their transfer by reconciling the number of entries with the number of reading sheets. This takes 15 to 30 minutes. The sheet also affords space to report vacant, locked and bad order instances. The clerks will then check the total consumption from the reading sheets, the daily summary tabulation of the meter readers and the totalizer on the billing machine. Monthly summaries and twelve months' running total from this daily data give a record of the character shown in the accompanying table, the actual figures for High Point from November 1, 1931, to November 1, 1932.

| Consumption Blocks | Average Consumers per Month | Average Consumption per Customer per Month, Kw.-Hr. | Total Consumption, Kw.-Hr. |
|---|---|---|---|
| 1. Domestic Lighting | | | |
| 0– 20 | 2,403 | 12.77 | 30,694 |
| 21– 40 | 1,909 | 28.21 | 53,850 |
| 41– 60 | 540 | 48.43 | 26,156 |
| 61– 80 | 163 | 68.71 | 11,228 |
| 81–100 | 61 | 89.46 | 5,494 |
| 101–150 | 37 | 120.11 | 4,504 |
| 151–200 | 7 | 169.12 | 1,198 |
| 200–up | 7 | 336.15 | 2,521 |
| Totals..... | 5,127 | 26.47 | 135,645 |
| 2. Domestic Power | | | |
| 0– 50 | 162 | 34.00 | 5,500 |
| 51–100 | 387 | 74.40 | 28,813 |
| 101–200 | 198 | 137.57 | 27,309 |
| 201–500 | 107 | 289.77 | 30,982 |
| 500–up | 19 | 835.06 | 16,075 |
| Totals..... | 873 | 124.06 | 108,179 |

Likewise the average individual use per month by residential customers was found to range from 17.81 in August to 37.25 in January for lighting and from 97.73 in March to 153.69 in September for domestic power. The combined usage had the much narrower range from 123 in March, 1932, to 176 in September, 1932.

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# READERS' FORUM

## Technocracy—Balancing—Character

*To the Editor of the* ELECTRICAL WORLD:

Your timely article "Balancing Technocracy" and spirited comments by D. R. Stevens are real contributions to the voluminous thought-provoking literature, inevitable during a period of national or world stress. Of all the many articles regarding the why and wherefore of the present "depression" few even hint and none emphasize what seems to me a fundamental factor, namely, average personal character. True, there are statements to the effect that our control over natural forces and practical applications of that knowledge have increased in recent decades enormously, while personal self-control, common virtues of unselfishness, honesty, respect for lives, feelings and property of other folks have shown no increase in degree and but a moderate spread among us all. The civilized world is "new rich" and reacts typically.

My reactions to your five general principles are much like Mr. Stevens'. I cannot see "decentralization," however, as the result of a deliberate, planned solution of this crisis. If that is really the long-term tendency for a considerable future, it will come, due to the same sort of forces that brought about our great industrial centers. I think every unit of every industry and most individuals will act 100 per cent according to whether a contemplated plan offers the best chance of improvement for its or his particular circumstances. There is yet little evidence of individual will to do that which will benefit most the greatest number.

If a great manufacturing plant decides to expand further only by building in another area the act is dictated by reasons relating to the plant first; well and good, should it prove part of a generally beneficial movement.

As individuals, how many persons in high or low position and paid from public funds put public service ahead of personal profit, except under the artificial stimulus of war fever?

I am no pessimist. I believe national, even world character is slowly rising. Education, fundamental religion, a growing belief in the Golden Rule will in time catch up with the scientific reaches of our minds. Meanwhile, let's stop proposing, as immediate panaceas, plans which will not be supported by the average character of all the people concerned. Above all, we should avoid schemes which will result in more law or increase local, national or racial differences.

Akron, Ohio. VERNE W. SHEAR.

# Men of the Industry

PERRY MCCART of Paoli, Ind., has been named chairman of the Indiana Public Service Commission.

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T. CAREY, recently elected a member of the Montana Railroad and Public Service Commission, has just been named chairman of that body.

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THOMAS N. MCCARTER, president of the Public Service Corporation of New Jersey, has been elected chairman of the board of directors of the Fidelity Union Trust Company of Newark.

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SAMUEL S. ARENTZ, Representative from Nevada, who was defeated in the last election, has been appointed a member of the Federal Power Commission to fill the vacancy left by the death of Ralph B. Williamson, who was vice-chairman. The term expires next June.

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R. B. BEALE, formerly assistant manager of the turbine sales department of the General Electric Company, has been appointed manager of the company's new turbine division, following the consolidation of what was previously the turbine sales department with the central-station department. Mr. Beale has been connected with the General Electric Company since 1899.

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JAMES F. FOGARTY of New York, vice-president of the North American Company, was elected president of North American Light & Power Company at a meeting of the board of directors in Chicago on January 30. His election filled the vacancy caused by the death of Edwin Gruhl, president of the North American Company, who became president of North American Light & Power Company in December. Mr. Fogarty has been a director of the company he has been selected to head for almost a year.

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ELMER E. GILBERT, sales manager of the turbine department of the General Electric Company, retired January 1 after more than 43 years of service with the company and the Thomson-Houston Electric Company. His career with General Electric completely spanned the period during which the steam turbine has been developed into one of the dominant factors in the economic progress of the nation. Mr. Gilbert directed turbine sales for General Electric for approximately 30 years. He was trained as an electrical and mechanical engineer at Rose Polytechnic Institute and immediately after the completion of his course began work as a test man at Lynn. Two years later he was transferred to the New York office and in 1892, a few months after the formation of the General Electric Company, he became one of the sales staff in the lighting department of the New York office. In 1898 he was assigned to the lighting department in Schenectady. It was in 1906 that Mr. Gilbert, already an outstanding turbine salesman, was made manager of sales in the turbine department.

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WENDELL L. WILLKIE, who has been elected president of the Commonwealth & Southern Corporation (ELECTRICAL WORLD, January 28, page 143), at the present time is serving on the directorate of Consumers Power Company, Ohio Edison Company, Alabama Power Company and other utility corporations as well as on Commonwealth & Southern.

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GEORGE H. A. MONTGOMERY, one of the most prominent members of the legal profession in the Province of Quebec, has been made a vice-president of Montreal Light, Heat & Power Consolidated. Mr. Montgomery first became associated with the Montreal utility company in 1905 when he assumed charge of the legal department. In 1907 he joined the legal firm of Brown, Montgomery & McMichael and since that time has acted as legal counsel for the company. He has been a member of the directorate since 1917.

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WILBUR M. KRISE, for the last thirteen years manager of the Potomac Light & Power Company at Martinsburg, W. Va., has recently been appointed general manager of the Northern Virginia Power Company, with headquarters in Winchester, to succeed E. D. Stultz, who has assumed new duties in Hagerstown, Md. Mr. Krise has had extensive experience with public utility enterprises since graduating from Drexel Institute, Philadelphia. Prior to his connection at Martinsburg he was identified with the Potomac Edison system at Waynesboro, Pa.

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DR. JAMES S. THOMAS, economist for the Commonwealth & Southern Corporation since 1929, has resigned to become president of the Clarkson Memorial College of Technology, Potsdam, N. Y. He is now confined to a hospital at Gadsden, Ala., as a result of an automobile accident in which several bones were broken, but it is expected that he will be able to leave the hospital in a short time. Prior to joining Commonwealth & Southern, Dr. Thomas did some special work for the Alabama Power Company in which he made a survey of Alabama's resources.

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## OBITUARY

SIGMUND VON GAISBERG SCHOECKINGEN, a pioneer of the electrical engineering industry in Germany, died recently, in Neudegg, in his seventy-seventh year. Mr. Schoeckingen was for many years with the Siemens-Schuckert organization and was the compiler of "The Pocket Gaisberg," a reference book for electrical engineers which has run to no fewer than 89 editions.

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FRANKLIN W. SPRINGER, professor of electrical engineering at the University of Minnesota, died January 23, in his sixty-third year. A graduate of the University of Minnesota, he joined the teaching staff of that institution in 1896 and in 1908 was assigned to the professorship he now holds in the electrical engineering department. Professor Springer had to his credit twenty patents covering laboratory equipment and service arrangements and in the course of his academic career contributed numerous reports and articles to the technical press. He was a fellow of the American Institute of Electrical Engineers and of the Society for the Promotion of Engineering Education.

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PROF. WILLIAM L. ROBB, head of the department of electrical engineering at Rensselaer Polytechnic Institute since 1902, died January 26, at Troy, N. Y., from congestion of the lungs. He was 71 years of age. Before becoming identified with Rensselaer Polytechnic Professor Robb taught mathematics at Columbia University and physics at Trinity College. During his academic career at Troy he had been in demand frequently as a consulting engineer. A native of Saratoga, N. Y., and a graduate of Columbia

versities of Würzburg and Berlin, Germany, and also attended the Federal Polytechnic Institute in Zurich, Switzerland. Professor Robb was a member of the American Institute of Electrical Engineers, the American Physical Society and of other technical associations.

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G. S. KEMP, who was associated with Guglielmo Marconi when the young inventor went to England in 1896, died at Southampton early in January, following an attack of bronchitis. He was 75 years old and was still in the employ of the Marconi Company at the time of his death. Mr. Kemp was intimately associated with the development of radio from the times when a range of three or four miles was considered remarkable, and his knowledge and carefully preserved records of Marconi's early work were accepted as being authoritative in the courts of law. Mr. Kemp was very widely known in the electrical and radio engineering industries.

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CLARENCE S. HAMMATT, state engineer of Florida, died recently at his home in Jacksonville in his seventy-fourth year. Mr. Hammatt had long been an outstanding figure in engineering circles in that state, having been associated with numerous public utility companies there and also in Georgia. For some twenty years he had been consulting engineer for the board of commissioners of state institutions of the state of Florida, was president of the (national) State Board of Engineering Examiners and a charter member and past-president of the Florida Engineering Society. Mr. Hammatt was said to be the oldest member of the American Institute of Electrical Engineers in point of service in the Florida section.

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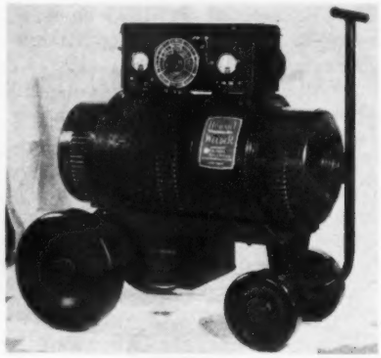
JOHN A. REED, executive vice-president of the Central State Electric Company and the Iowa Electric Company, vice-president of the Iowa Electric Light & Power Company and president of nearly a dozen smaller utility companies, died January 20, in his home in Cedar Rapids, following a heart attack. He was 65 years of age. For more than four decades Mr. Reed had been outstanding in the legal profession in Cedar Rapids and the office he opened there after his graduation from the University of Iowa law school was maintained in the same location several years. In 1903 he turned his attention to utility affairs and in association with others became interested in the organization which later became the Iowa Electric Light & Power Company. He was general counsel for the Iowa Electric Company when it was formed in 1911 and three years later the company which was destined to become the Central State Electric was organized. Mr. Reed was a past-president of the Iowa section of the National Electric Light Association.

# New Equipment Available

## Improved Portable Welder

In a newly designed portable welding machine, costing no more than previous models, Hobart Brothers Company, Troy, Ohio, offers 60 per cent more capacity and the use of either coated



rods, with their 42-volt requirements, or 25-volt plain rod. This unit is easy to operate and virtually waterproof due to a new type of louver. Another important feature is the remote control that permits the operator to weld 50 to 100 ft. away from the welder yet have full and instantaneous control.

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## Chromoxide Wire Has Heat-Resistance Insulation

Heat-resistance insulation known as "Vega Chromoxide," which represents a new development in wire insulation, has been announced by the American Enameled Magnet Wire Company, Port Huron, Mich. It comprises essentially a finely divided dielectric heat-resistant inorganic insulation, mainly chromium oxide. Combined with this is an inorganic binder effective at high temperature and an organic water-insoluble insulator added for structural purposes.

In motor and other coil windings the heat-resistant green chromium oxide provides an indestructible residual spacing element between turns, thereby preventing failures due to wire insulation burnouts. This provides a safety factor of dual importance and value.

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FOR POWER PLANT, field and service work and for general testing, a new vibrometer is announced by the Starrett Company, Athol, Mass. The instrument consists of a flexibly supported mass and a dial indicator, fastened to the end of a thumb screw and supported by the mass, to measure the amplitude. Laboratory tests show that the vibrometer is reliable for frequencies as high as University, he studied at the Uni- 600 r.p.m. when the amplitude does not exceed 0.004 in., and at lower speeds for much higher amplitudes.

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FAN SEAL TYPE MOTORS in sizes ranging from 2 hp. at 900 r.p.m. to 30 hp. at 1,800 r.p.m. have been announced by the Marble-Card Electric Company, Gladstone, Mich. It is claimed that the new type motor is self-cooling, self-cleaning, self-protecting and, being entirely inclosed, is free from such hazards as dust, dampness and fumes.

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IMPOVEMENT IN THE "EVEREADY" air cell "A" battery, which, unlike the original air cell, is prepared for service by a single filling of water, is announced by the National Carbon Company, Inc. The battery retains all of the characteristics of the original air cell, including the special impregnated carbon lungs, which literally breathe oxygen from the air to maintain constant voltage over a long life. The main feature of the new design is the elimination of the necessity for a second filling of water in putting the battery into service.

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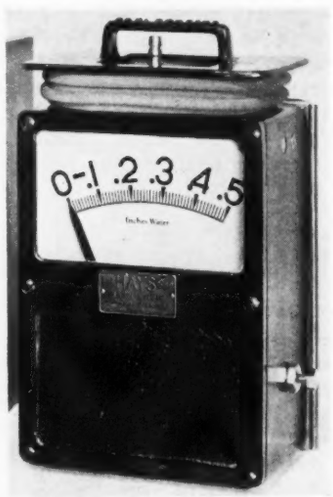
## Dry Type Portable Style Draft Gage

A new dry type portable style draft gage has been announced by the Hays Corporation, Michigan City, Ind. It is stated that the new gage can be set up for service in 30 seconds and does not require leveling. The standard ranges offered are either ½ in. or 1-in. water.




Differential type can also be supplied for indicating resistance gas or air flow, for forced draft stokers two pointer gages are offered. The new gage weighs only 4¾ lb. Its over-all dimensions are 5x4x9 in. and has a scale length of 3 in.